CHAPTER 5

EMPLOYMENT

Overview

Women, minorities, and persons with disabilities are a smaller proportion of the science and engineering labor force than they are of science and engineering degree recipients. Women earned 43 percent of combined bachelor's, master's, and doctoral science and engineering degrees in 1993 (see appendix tables 3-25, 4-20, and 4-23) but were 22 percent of the science and engineering labor force.[1] (See appendix table 5-1.) Blacks, Hispanics, and American Indians were 6 percent and persons with disabilities were 5 percent of the science and engineering labor force. (See appendix tables 5-2 and 5-3.)

As data in chapters 3 and 4 show, the fraction of science and engineering degrees going to women and minorities has increased over time. Because the labor force is composed of many years' worth of degree recipients and because women and minorities were a smaller fraction of earlier years' degree recipients, one would expect women and minorities to be a smaller fraction of the labor force as a whole than they are of current degree recipients. Among those who received degrees since 1990, the fraction of the science and engineering labor force who are women and minorities is much larger: 32 percent are women, and 8 percent are black, Hispanic, or American Indian. (See appendix table 5-4.)

Even among the more recent graduates, one would not expect the proportion in the labor force to equal the proportion of degrees. Taxonomy differences in science and engineering education and employment make it difficult to compare participation in science and engineering education with participation in science and engineering employment. Some who receive degrees in what is counted as science and engineering and consider themselves to be employed in their field may not be counted as being employed in science and engineering occupations. As an example, some who receive degrees in sociology (a science degree) become social workers (a nonscience occupation). Because of these taxonomy differences, field differences among men and women science and engineering degree recipients may influence participation in the science and engineering labor force.

This chapter examines the participation and employment characteristics of women, minorities, and persons with disabilities in the science and engineering labor force. Much of the data for this chapter come from NSF's SESTAT (Scientist and Engineer Statistics Data System) surveys.[2] The 1993 surveys are substantially different from those conducted in the 1980s in terms of the sample, question wording, and response rates. In most cases, therefore, it is not possible to present meaningful trend data. Data on science and engineering faculty come primarily from the NCES 1993 National Study of Postsecondary Faculty. See the appendix for more information on data sources.

Women Scientists and Engineers

Women are 22 percent of the science and engineering labor force as a whole (see figure 5-1) and were 20 percent of doctoral scientists and engineers in the United States in 1993, compared with 19 percent in 1991.[3]

Field

Within science and engineering, women are more highly represented in some fields than in others. Women are more than half of sociologists and psychologists but are only 9 percent of physicists and 8 percent of engineers. (See appendix table 5-1.) Doctoral women scientists and engineers are likewise more heavily represented in some fields than in others. For example, women are 41 percent of doctoral psychologists, and 28 percent of biologists but only 4 percent of engineers. (See figure 5-2.)

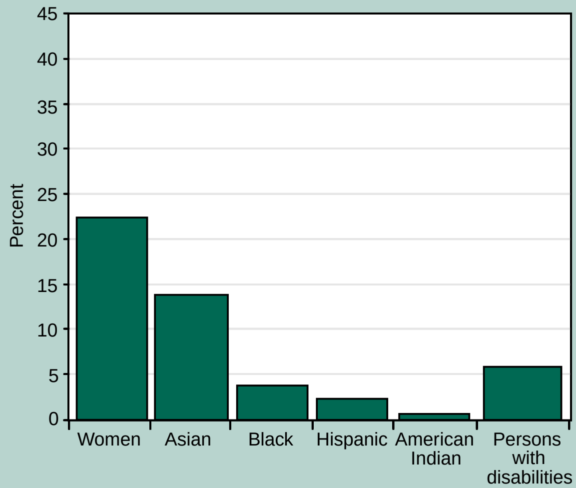
In many fields, women scientists and engineers are much more likely than men to have the bachelor's degree as their highest degree. Women are 32 percent of bachelor's computer/mathematics scientists but only 18 percent of doctoral computer/mathematics scientists. (See appendix table 5-1.) Because of these differences in highest degree, the science and engineering work done by women is often very different from that done by men. For example, in the biological sciences, women are

[1] Includes science- and engineering-related occupations and postsecondary science and engineering teachers.

[2] Totals may vary from table to table because of differences in the population referred to in the table and because of "no reports."

[3] For 1991 figures, see *Women, Minorities, and Persons With Disabilities in Science and Engineering: 1994,* p. 95.

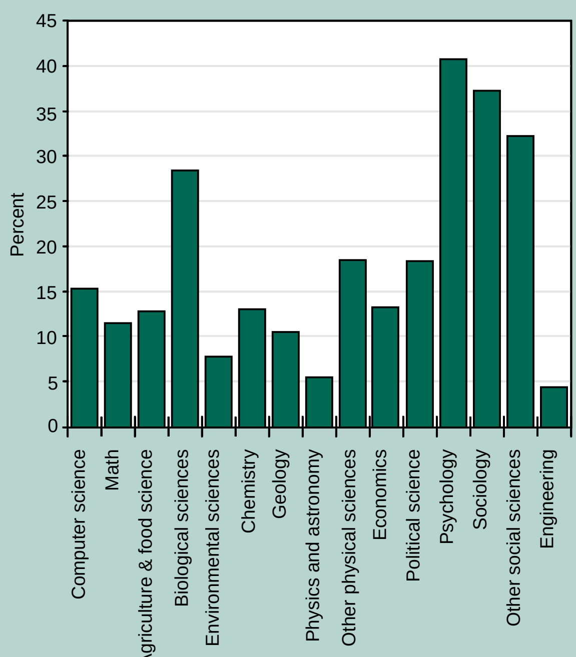
Figure 5-1.
Women, minorities, and persons with disabilities as a percentage of scientists and engineers in the labor force: 1993



See appendix tables 5-1, 5-2, and 5-3.

NOTE: The percentages here are not mutually exclusive.

Figure 5-2.
Women as a percentage of doctoral scientists and engineers in the labor force, by field of doctorate: 1993



See appendix table 5-5.

47 percent of the bachelor's biological scientists and only 29 percent of the doctoral biological scientists. (See appendix table 5-1.) Biological scientists with bachelor's degrees may have as their primary activity testing and inspection or technical sales or service, or they may be biological technicians, medical laboratory technologists, or research assistants. Biological scientists with doctoral degrees typically teach in universities, perform independent research, or are managers or administrators in industry.[4]

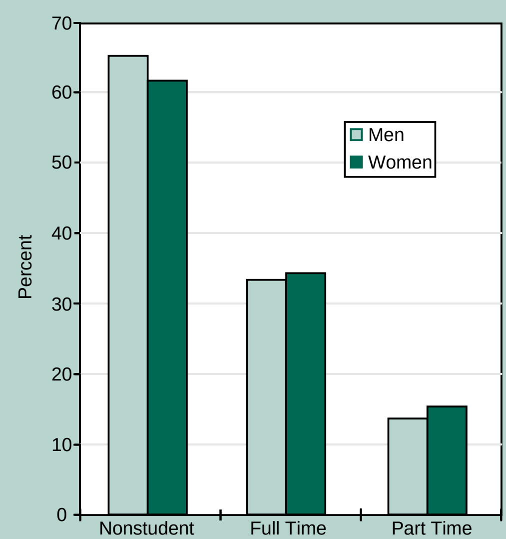
Employment and Unemployment

Bachelor's and Master's Scientists and Engineers

Recent men and women bachelor's science and engineering graduates are similar in their pursuit of postgraduation education but differ in employment status. About 30 percent of new bachelor's graduates do not immediately seek employment. Instead, they pursue graduate study either full time or part time. (See figure 5-3.) In 1993, women and men 1992 science and engineering graduates were about as likely to be enrolled in graduate school (32 percent of women versus 29 percent of men). (See appendix table 5-6.)

Recent men and women bachelor's graduates differ more in postgraduation employment status than they do in postgraduation education. Men bachelor's science and engineering graduates are more likely to be in the labor force, to be employed full time, and to be

Figure 5-3.
Percentage of 1992 bachelor's science and engineering graduates in full- or part-time graduate study, by sex: 1993



See appendix table 5-6.

[4] U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Outlook Handbook, 1994–95.* May 1994, Bulletin 2450.

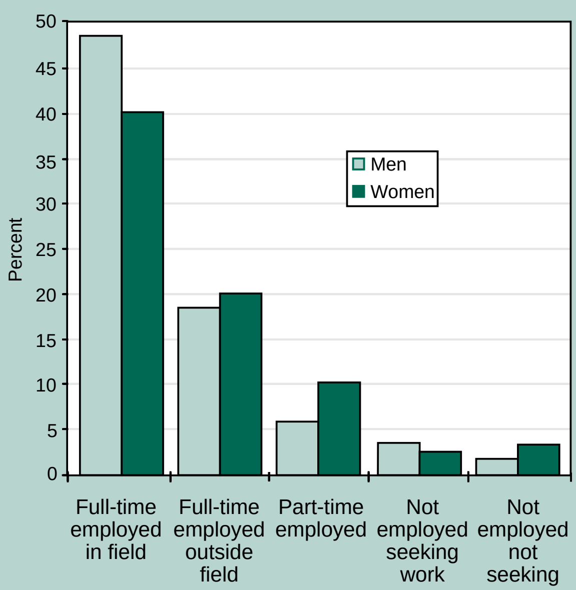
employed in their field than are women. (See figure 5-4.) Women are more likely than men to be out of the labor force, to be employed part time, and to be employed outside their field. Women are 44 percent of the 1992 bachelor's science and engineering graduates but are 58 percent of those out of the labor force (i.e., not employed and not seeking employment), 54 percent of those employed part time, and 47 percent of those employed full time outside their field. (See appendix table 5-6.)

Some of these differences are due to family-related reasons, often demands of a spouse's job or presence of children. Among recent bachelor's graduates, 29 percent of women but only 1 percent of the men who are not employed cited family responsibilities as the reason for not working. (See appendix table 5-7.)

Field differences contribute to some of these differences in employment status as well. Undergraduate education in science and engineering is not necessarily preparation solely for science and engineering employment. Science and engineering education at the undergraduate level is broadly applicable in a number of fields outside science and engineering.

Among employed recent science and engineering bachelor's graduates, women are less likely than men to be employed in science and engineering occupations. Only 18 percent of the employed new women graduates compared with 35 percent of the new men graduates are employed in science and engineering. (See appendix table 5-8.) Those who are not employed in science and engineering occupations are, for the most part, in related occupations, such as clinical psychology, social work, management, secondary education,[5] and sales and marketing. (See figure 5-5.) Because they are more likely than men to earn degrees in the social sciences, women are more likely than men to be employed in social services and related occupations and, because of family concerns, cultural norms, or personal preference, are more likely than men to be employed in secondary education.

Figure 5-4.
Employment status of 1992 bachelor's science and engineering graduates, by sex: 1993



See appendix table 5-6.

NOTE: A respondent is employed "in field" if he or she responded that his or her current work is "closely related" or "somewhat related" to degree. Employment status excludes full-time students.

Part of the reason women bachelor's science and engineering graduates are less likely than men to be employed in science and engineering occupations is that women are not highly represented in fields in which a bachelor's degree is sufficient for employment within the field. Engineering and computer science, fields in which women are not highly represented, typically provide "professional" employment with bachelor's degrees. Thus, new bachelor's graduates in these fields are likely to find employment in their field: 72 percent of 1992 bachelor's computer science graduates and 65 percent of new bachelor's engineering graduates found full-time employment in their field.

Other fields typically require graduate education for "professional" employment in the field. New bachelor's graduates in these fields are least likely to be employed within their field. Life sciences and social sciences, fields in which women are highly represented, are two such fields: only 37 percent of 1992 bachelor's social science graduates and 32 percent of 1992 bachelor's life science graduates found full-time employment in their field.

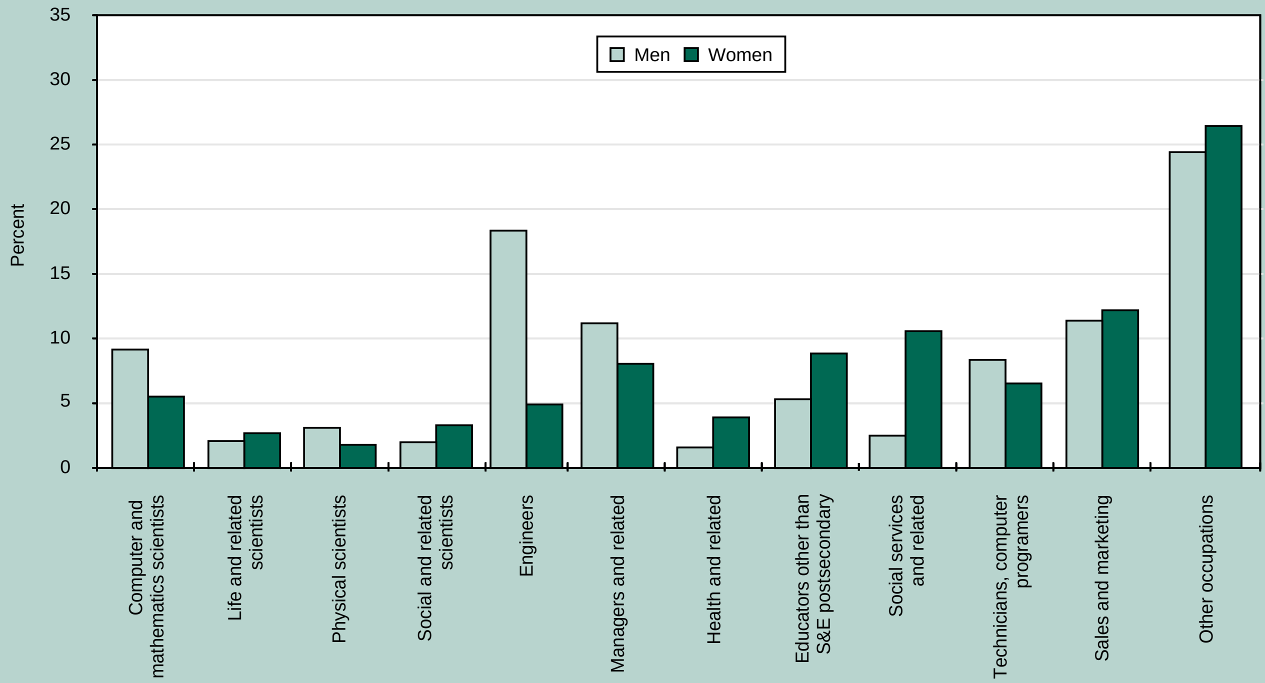
Unemployment rates of men and women recent bachelor's graduates do not differ greatly: 4.1 percent of women and 4.7 percent of the men 1992 bachelor's science and engineering graduates were unemployed in April 1993. (See appendix table 5-6.)

Doctoral Scientists and Engineers

The overall labor force participation rates of doctoral men and women scientists and engineers are similar—about 92 percent of both men and women are in the labor force. The labor force participation rates of men and women who received their doctorate in similar time periods are quite different, however. Within degree cohorts, men have higher labor force participation rates than women. For example, among 1980–1984 graduates, the labor force participation rate for men is 99.1 percent; for women, it is 93.8 percent. (See appendix table 5-9.) Because a higher fraction of men than women are in the earlier degree cohorts (e.g., those who received degrees before 1960) and those in earlier

[5] Secondary science and mathematics teaching is not considered employment in science or engineering because most who are employed in this area have degrees in education, not in science or engineering. Only 29 percent of the science and mathematics secondary teachers responding to the National Survey of College Graduates had degrees in science or engineering.

Figure 5-5.
Occupations of employed 1992 bachelor's science and engineering graduates, by sex: 1993.



See appendix table 5-8.

degree cohorts have lower labor force participation rates, largely due to retirements, men's overall participation rate averages out to about the same as women's.

Among doctoral scientists and engineers, 12 percent of women and 4 percent of men are employed part time. (See appendix table 5-10.) Women who are employed part time are far more likely than men to cite family responsibilities as the reason. (See appendix table 5-11.) About half of the doctoral women working part time and about 5 percent of the men cited family responsibilities as the reason for working part time. Women with children under age 18 are more likely than men with or without children and women without children to work part time or to be unemployed. (See appendix table 5-12.)

Women and men who have children face the problem of trying to balance work and family. Twenty-one percent of doctoral women scientists and engineers with children under 18, but only 2 percent of comparable men, are employed part time. Both men and women face the problem of balancing work and family when employers demand primary commitment to work. Even companies with family-friendly programs frequently discourage their use.[6]

New doctoral scientists and engineers are more likely than bachelor's scientists and engineers to find employment in their field. Among full-time employed doctoral scientists and engineers, 93 percent are employed in their field, compared with 70 percent of full-time employed bachelor's scientists and engineers. (See appendix tables 5-6 and 5-10.) Doctoral women who are employed full time are as likely as men to be in jobs related to their degree.

Family status influences exit rates out of science and engineering employment. Married scientists and engineers and those with children are more likely to leave science and engineering employment than those who are not married and do not have children.[7] Within each family status category, however, differences between men and women remain. Single women are more likely than single men to leave science and engineering employment. Married women without children are more likely than married men without children to leave science and engineering employment, and women with children are more likely than men with children to leave science and engineering employment.

6 Committee on Women in Science and Engineering, National Research Council. 1994. *Women Scientists and Engineers Employed in Industry: Why So Few?* Washington, DC: National Academy Press.

7 Preston, Anne E. 1994. Presentation on "Occupational Departure of Employees in the Natural Sciences and Engineering" cited in Committee on Women in Science and Engineering, National Research Council Committee on Women in Science and Engineering. 1994. *Women Scientists and Engineers Employed in Industry: Why So Few?* Washington, DC: National Academy Press.

Women's Persistence in Science After Graduation

Rayman and Brett (1995) found parental encouragement and attitudes about work and family to be important determinants of women's persistence in science after graduation. Other factors influencing persistence included encouragement from college teachers, having had a mentor as an undergraduate, having received career advice from faculty, having had an undergraduate research experience, and having a high interest in science.

Parental encouragement contributed significantly to whether or not a woman stayed in science after graduation. Encouragement from either mothers or fathers was important, and encouragement from both together was even better. Using a logistic regression model, the authors calculated that the odds of science majors staying in science after graduation were 2.6 times greater if one parent gave a lot of encouragement and 6.7 times greater if two parents gave a lot of encouragement. Family characteristics, such as parental education and occupation, were not related to persistence although they are related to choice of major in science or mathematics.

In this study, three groups of women who majored in science and mathematics as undergraduates at a leading women's college were characterized by persistence in science: "leavers" left the sciences immediately after graduation, "changers" switched to other occupations sometime after graduation, and "stayers" remained in the sciences.

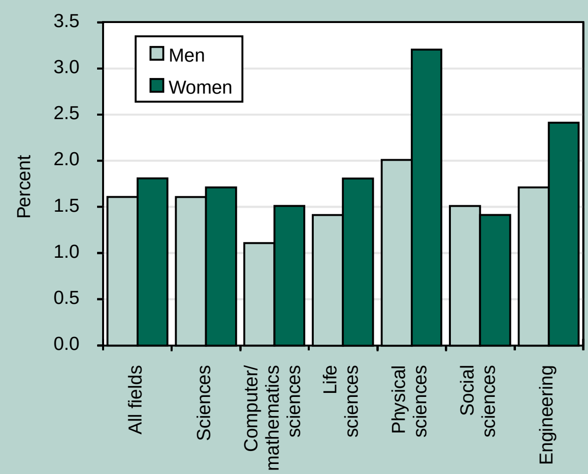
Among the three groups, stayers were most likely to have received encouragement from their parents, especially their mothers, to pursue a career in science. They were least likely to believe their current occupation was compatible with family life.

Changers were most likely to have received a lot of encouragement from mothers and to have had mothers in science or health-related occupations. They were also more likely to have moved for a spouse, to have worked less than full time to provide caregiving, and to be in nonscience occupations that were compatible with family life. Both leavers and changers were more likely than stayers to believe that mothers with infants should not work at all. Changers were less likely than the other two groups to have had encouragement from mothers to pursue a career in science, to have had encouragement from college teachers, to have had a mentor, to have received career advice from faculty, and to have had undergraduate research experiences.

Leavers were less likely than the other two groups to have had a father or mother in science; to have had a mother who went to college; to have received a lot of encouragement from mothers, fathers, or college teachers to major in or pursue a career in science; to have received career advice from advisors; to have done undergraduate research; and to have a high interest in science.

Women doctoral scientists and engineers are more likely than men to be unemployed, although the difference is small. The unemployment rate[8] for doctoral women in 1993 was 1.8 percent; for men it was 1.6 percent.[9] (See figure 5-6.) Within fields, the differences in unemployment rates are larger, especially in the fields that have fewer women. For example, among physical scientists, the unemployment rate for women is 3.2 percent compared with a rate of 2.0 percent for men. (See appendix table 5-13.) Among engineers, the unemployment rate for women is 2.4 percent compared with a rate of 1.7 percent for men. Among social scientists, on the other hand, the unemployment rates are more nearly equal—1.4 percent for women and 1.5 percent for men.

Figure 5-6.
Unemployment rates of doctoral scientists and engineers, by field of doctorate and sex: 1993.



See appendix table 5-13.

8 The unemployment rate measures the percentage of those in the labor force who are not employed but are seeking work.

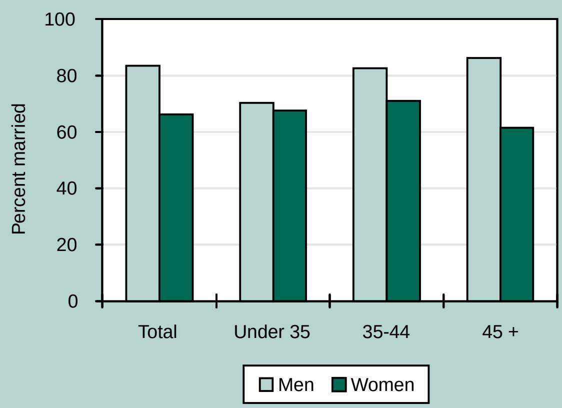
9 The difference in unemployment rates is statistically significant, i.e., it is larger than expected from chance fluctuations.

Are Marriage and Science Compatible for Women?

Doctoral women scientists and engineers are far less likely than men to be married: 66 percent of women doctoral scientists and engineers are married, compared with 83 percent of men. (See figure 5-7.) Doctoral women are twice as likely as men never to have married or to be divorced. Twelve percent of the women, but only 6 percent of the men, were divorced, and 19 percent of the women, but only 9 percent of the men, were single and never married.

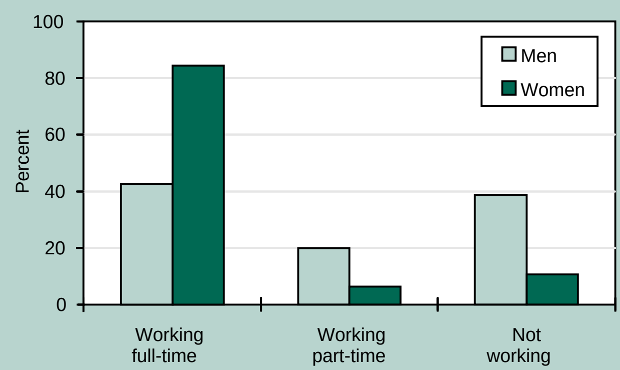
Women scientists and engineers who are married are more likely than men to be married to a scientist or engineer. (See figure 5-9.) Fifty-five percent of women, but only 32 percent of men, are married to a natural scientist or engineer.

Figure 5-7.
Percentage of doctoral scientists and engineers who are married, by age and sex: 1993



SOURCE: National Science Foundation/SRS. 1993 Survey of Doctorate Recipients.

Figure 5-8.
Percentage of married doctoral scientists and engineers, by employment of spouse and sex of respondent: 1993

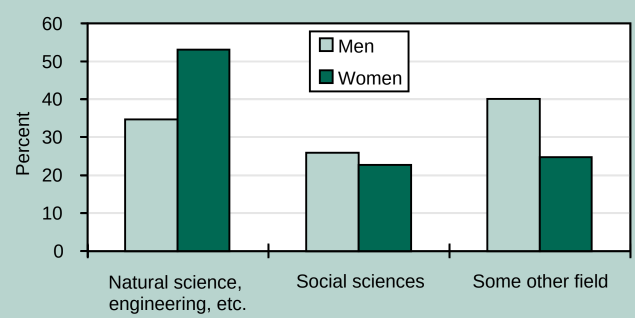


SOURCE: National Science Foundation/SRS. 1993 Survey of Doctorate Recipients.

One factor in the differing marital status of men and women scientists and engineers is the younger ages of the women—16 percent of the doctoral women, but only 10 percent of the doctoral men, are younger than 35. Among younger doctoral scientists and engineers, more nearly equal proportions of men and women are married. Among those 35 or older, however, women are far less likely than men to be married. For example, among doctoral scientists and engineers between the ages of 45 and 54, 64 percent of the women, compared with 85 percent of the men, are married.

Among those who are married, women scientists and engineers are also more likely than men to face problems in accommodating dual careers. Doctoral women are twice as likely as men to have a spouse working full time. (See figure 5-8.) Eighty-four percent of the married women, but only 42 percent of the married men, have a spouse working full time. Only 10 percent of the married women, but 38 percent of the married men, have a spouse not working.

Figure 5-9.
Percentage of married doctoral scientists and engineers, by spouse occupation and sex of respondent: 1993



SOURCE: National Science Foundation/SRS. 1993 Survey of Doctorate Recipients.

Sector of Employment

Bachelor's and master's scientists and engineers are employed predominantly in business or industry. Seventy-two percent of bachelor's scientists and engineers, and 56 percent of master's scientists and engineers are employed in this sector. (See appendix tables 5-14 and 5-15.) Doctoral scientists and engineers, on the other hand, are employed in diverse sectors: 45 percent are employed in universities or 4-year colleges, 30 percent are employed in business or industry, 10 percent are employed in government, and 15 percent are employed elsewhere. (See appendix table 5-16.)

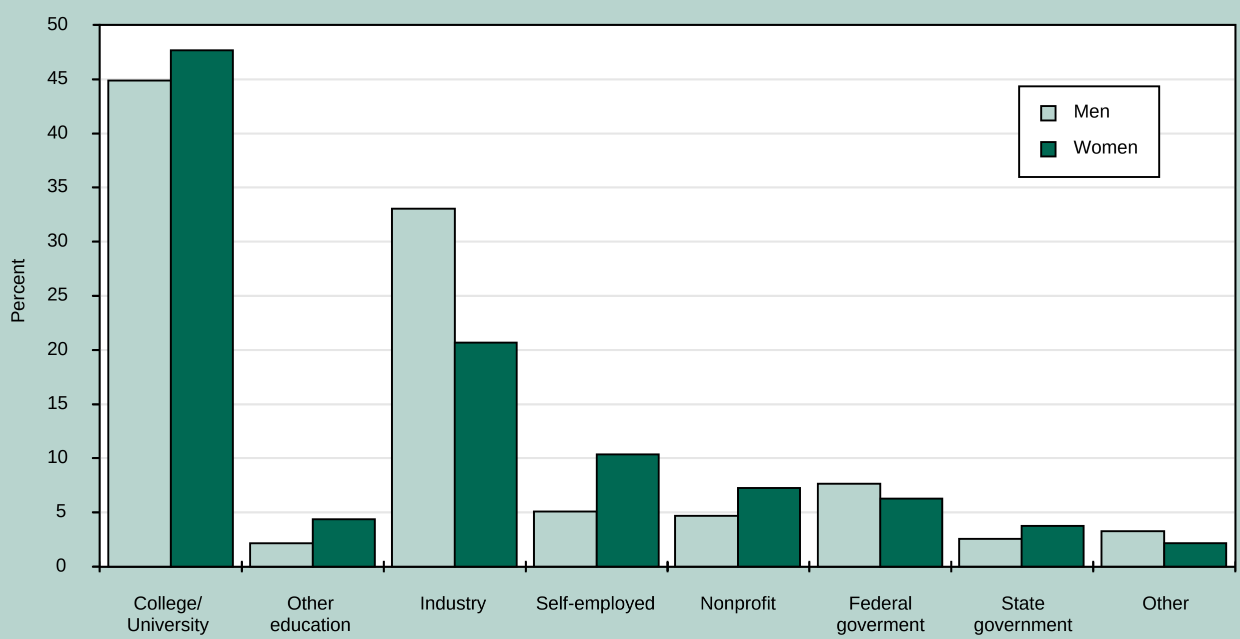
Among bachelor's and master's scientists and engineers, women, minorities, and persons with disabilities are less likely than scientists and engineers as a whole to be employed in business or industry and are more likely to be employed in educational institutions. For example, among master's scientists and engineers, 63 percent of men and 39 percent of women are employed in business or industry and 16 percent of men and 32 percent of women are employed in educational institutions. (See appendix table 5-15.)

Among doctoral scientists and engineers, women are also less likely than men to be employed by private for-profit employers and are more likely than men to be employed in colleges and universities or to be self-employed. (See figure 5-10.) These differences in sector are mostly related to differences in field of degree. (See appendix table 5-17.) For example, women are less likely than men to be engineers or physical scientists, who tend to be employed by private for-profit employers. Forty-four percent of doctoral physical scientists and 53 percent of doctoral engineers are employed in business or industry, compared with 30 percent of all scientists and engineers. Within fields, women are about as likely as men to choose industrial employment, although some evidence indicates that women leave industrial employment at a greater rate than men.[10] The climate in industry may be perceived as less favorable to women for a number of reasons including recruitment and hiring practices, a corporate culture hostile to women, sexual harassment, lack of opportunities for career development and critical developmental assignments, failure to accommodate work-family issues, lack of mentoring, and lack of access to informal networks of communication.[11]

[10] Anne Preston, "A Study of Occupational Departure of Employees in the Natural Sciences and Engineering," National Research Council Committee on Women in Science and Engineering conference, Irvine, CA, January 17, 1993.

[11] Federal Glass Ceiling Commission, "Good for Business: Making Full Use of the Nation's Human Capital," March 1995. U.S. Department of Labor. Washington, DC. See also Committee on Women in Science and Engineering, National Research Council, *Women Scientists and Engineers Employed in Industry: Why So Few?* 1994. Washington, DC: National Academy Press.

Figure 5-10.
Sector of employment of doctoral scientists and engineers in the labor force, by sex: 1993



See appendix table 5-16.

Women's greater tendency to be self-employed is also related to field of degree. For example, women are more likely than men to be psychologists, and psychologists are more likely than other scientists and engineers to be self-employed. Twenty-two percent of doctoral psychologists are self-employed, as opposed to only 6 percent of all scientists and engineers. (See appendix table 5-17.)

Academic Employment

The employment characteristics of women in colleges and universities are quite different from those of men. Women faculty differ from men in terms of teaching field, type of school, full-time or part-time employment, contract length, primary work activity, research productivity, rank, and tenure. The fields in which men and women faculty teach differ. Women faculty as a whole are less likely than men to be science and engineering faculty. Women are 44 percent of faculty in non–science-and-engineering fields but only 24 percent of science and engineering faculty. (See appendix table 5-18.) Within science and engineering, women faculty are a relatively small fraction of physical science and engineering faculty and are more highly represented among mathematics and psychology faculty. Women are 43 percent of psychology faculty and 31 percent of mathematics faculty but only 14 percent of physical science and 6 percent of engineering faculty.

The types of schools in which men and women teach differ. Women science and engineering faculty are far less likely than men faculty members to be employed in research universities and are far more likely to be employed in public 2-year schools. (See figure 5-11.) Differences in type of school are related to faculty employment status. Women science and engineering faculty are much more likely than men to teach part time (40 percent versus 25 percent). (See appendix table 5-19.) Two-year schools are much more likely than 4-year schools to hire part-time faculty. More than half of faculty, regardless of sex, who work in 2-year schools work part time. (See appendix table 5-21.)

Women are also more likely than men to have fixed-term contracts. Fifty-four percent of women science and engineering faculty are on a one-term or 1-year contract, compared to 34 percent of men. (See appendix table 5-20.) Some evidence indicates that such contracts are becoming more prevalent. Over the last 5 years, colleges and universities have moved toward replacing tenured or tenure-track positions with fixed-term contracts.[12]

The differences among men and women faculty in type of schools and employment status are partly related to the highest degree obtained. Fewer women than men science and engineering faculty have a PhD degree. A far higher proportion of women (42 percent) than men (24 percent) faculty have a master's degree as their highest degree. (See appendix table 5-22.)

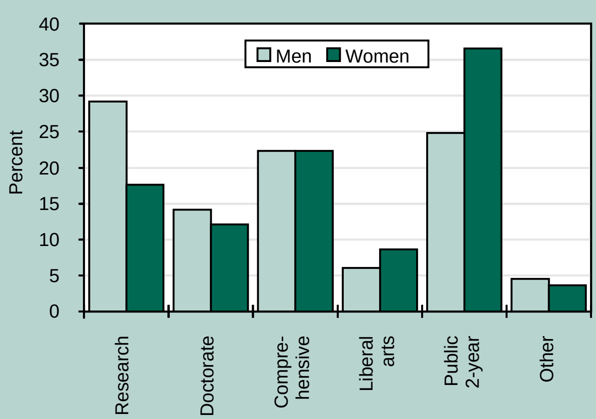
Partly because of the types of schools in which they are employed, women science and engineering faculty are more likely than men to be involved primarily in teaching. (See appendix table 5-23.) Not only do they spend more time teaching than men, they also are more likely than men to report they prefer teaching to research. Within school types, men and women faculty are more nearly the same in the amount of time spent in teaching or research and in the preferred amount of time spent in teaching or research.

Women science and engineering faculty also do less research than men faculty. Women are less likely than men to be engaged in funded research, to be a principal investigator or co-principal investigator (see appendix table 5-24), or to have published books or articles in the previous 2 years (see appendix table 5-25). These differences remain even within research universities and among all age groups.

Among full-time science and engineering faculty, women are less likely to chair departments, are less likely to reach the highest academic ranks, and are less likely to be tenured than men. Eleven percent of women but 14 percent of full-time men science and engineering faculty chair departments. (See appendix table 5-26.)

Women scientists and engineers hold fewer high-ranked positions in colleges and universities than men. Women are less likely than men to be full professors and are more likely than men to be assistant professors or instructors. (See figure 5-12.) Part of this difference in rank can be explained by age differences, but differences in rank remain even after controlling for age. Among those who received their doctorate 13 or more years ago, 72 percent of men but only 55 percent of women are full professors. (See appendix table 5-27.)

Figure 5-11.
Distribution of science and engineering faculty, by type of school and sex: 1993



See appendix table 5-19.

[12] U.S. Department of Education, National Center for Education Statistics. 1996. *Institutional Policies and Practices Regarding Faculty in Higher Education Institutions, 1992.*

Women are also less likely than men to be tenured or to be on a tenure track. Forty-three percent of full-time employed women science and engineering faculty are tenured, compared with 67 percent of men. (See figure 5-13.) As was the case with rank, some of the differences in tenure may be attributable to differences in age.

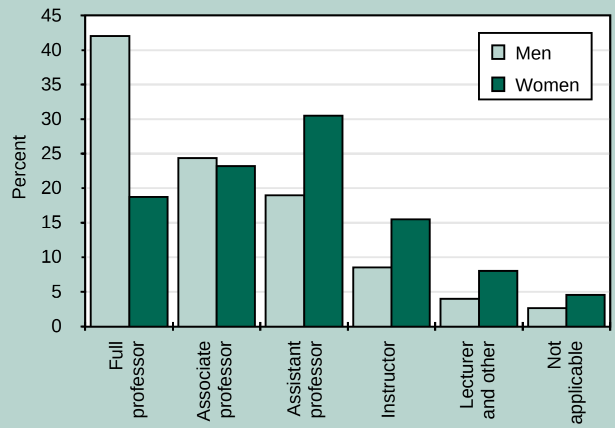
Nonacademic Employment

As noted earlier, bachelor's and master's scientists and engineers are employed primarily in business or industry, and women scientists and engineers are less likely than men to be employed in this sector. The type of work women scientists and engineers do also differs from that done by men. For example, 40 percent of bachelor's-level women but only 26 percent of bachelor's-level men report computer applications as their primary work activity. Thirteen percent of master's-level men and 9 percent of master's-level women are managers. (See appendix table 5-29.) Age differences largely explain differences in management status. Among bachelor's scientists and engineers between the ages of 30 and 39, roughly equal proportions of men and women are managers. Differences in field also have a lot to do with differences in primary work activities. For example, men are more likely than women to be engineers and are thus more likely to be engaged in development, design of equipment, and production.

Among doctoral scientists and engineers, nonacademic employment is more prevalent than academic employment in some fields, for example, chemistry and engineering. Women are less likely than men to be employed in these fields and are less likely than men to be employed in nonacademic settings.

Within business or industry, women doctoral scientists and engineers are less likely than men to be in management. (See figure 5-14.) Twenty-five percent of doctoral men scientists and engineers and 21 percent of doctoral women scientists and engineers are in management. As was the case with bachelor's- and master's-level scientists and engineers, this difference is largely attributable to differences in age. Among employed industrial scientists and engineers who received doctoral degrees since 1985, 10 percent of men and 13 percent of women are managers. Among those who received degrees between 1970 and 1979, 32 percent of both women and men are managers. (See appendix table 5-30.).

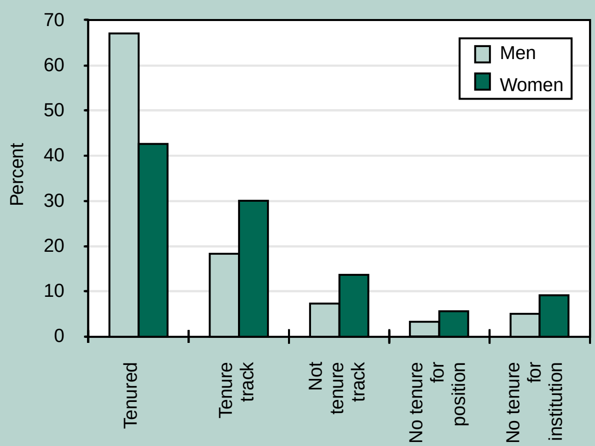
Figure 5-12.
Academic rank of full-time ranked science and engineering faculty, by sex: 1993



Includes faculty in all colleges and universities.

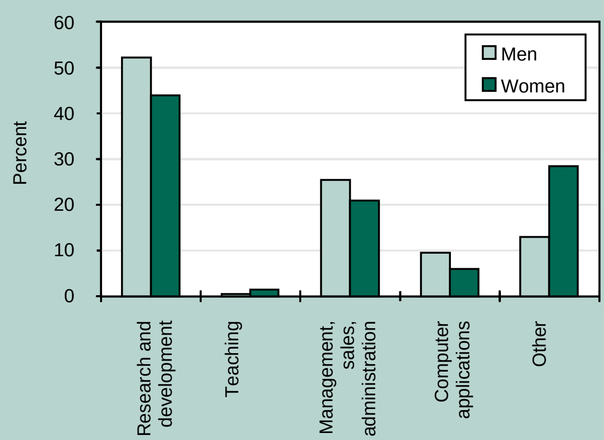
See appendix table 5-27.

Figure 5-13.
Tenure status of full-time science and engineering faculty, by sex: 1993



See appendix table 5-28.

Figure 5-14.
Primary work activity of doctoral scientists and engineers in business or industry, by sex: 1993



See appendix table 5-30.

Text table 5-1.
Median annual salaries of full-time employed 1992 bachelor's and master's science and engineering graduates by broad occupation and sex, 1993

Occupation	Bachelor's			Master's		
	Total	Men	Women	Total	Men	Women
Full-time employed in all fields	$23,000	$25,000	$20,000	$37,200	$39,000	$33,700
Computer and mathematics scientists	31,000	31,200	30,000	39,000	40,000	37,400
Life and related scientists	22,000	23,000	21,000	28,400	29,800	28,000
Physical scientists	25,000	25,000	26,500	36,000	36,000	32,000
Social and related scientists	19,200	20,000	18,000	27,800	31,000	25,600
Engineers	33,500	33,500	33,600	40,600	40,000	41,000
Managers and related	25,000	28,600	22,800	42,000	44,000	35,000
Health and related	17,700	19,200	15,500	28,400	30,000	28,200
Educators other than science and engineering	20,000	22,000	19,500	30,000	31,000	29,500
Social services and related	18,000	18,000	18,000	25,000	27,000	22,400
Technicians, computer programmers	25,200	25,500	22,900	34,000	33,800	34,000
Sales and marketing	22,500	22,700	22,000	25,000	27,000	22,400
Other occupations	18,000	18,700	17,700	26,400	28,000	23,000

SOURCE: National Science Foundation, National Survey of Recent College Graduates, 1993.

Salaries

Bachelor's and Master's Salaries

The 1993 median starting salary for recent women bachelor's science and engineering graduates was lower than that for men overall, largely because of differences in occupational field. Women are less likely than men to be computer/math scientists or engineers, who earn relatively high salaries. They are more likely than men to be social or life scientists, who earn relatively low salaries. Within fields, the median starting salaries for men and women were more nearly the same. (See text table 5-1.) For example, in engineering, the median salary for men was $33,500 and for women was $33,600. The starting salaries of men and women in computer and mathematical sciences, physical sciences, and sales and marketing were very similar.

Among more experienced bachelor's and master's scientists and engineers, the gap between men's and women's salaries is larger. (See appendix table 5-31.) As was the case for starting salaries, some of the differences in salary are due to differences in field. Salaries are highest in mathematical/computer science and engineering, fields in which women are not highly represented. Salaries are lowest in fields in which women are prevalent, such as life sciences and social sciences. Within each of these fields, the salaries of men and women are similar among those less than 30 years old, but differences between men's and women's salaries increase with increasing age. Such factors as number of years in the labor force, primary work activity, supervisory status, and number of people supervised also influence salaries and may account for some of the gap. The following section examines the influences on doctoral salaries, many of which also influence the salaries of those with bachelor's and master's degrees.

The Doctoral Gender Salary Gap

In 1993, among employed science and engineering doctorate-holders[13] who worked full time,[14] the average salary for women was $50,200 compared with $63,600 for men.[15] (See text table 5-2.) The observed gender salary gap of $13,300 is quite substantial and corresponds to women's making only 79 percent of what men make. As has been documented in this report, however, many differences between men and women in the doctoral labor force help explain this salary gap,[16] e.g., women are, on the average, younger than men and have more frequently majored in fields such as the social sciences that have relatively low pay.

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[13] The salary gap analysis focuses only on the doctoral salary gap. The salary gaps for those with bachelor's and master's degrees are, of course, also of interest, but time limitations and data availability did not permit such analyses for this report.

[14] Those sections of this chapter that analyze the salary gap exclude those who are self-employed and those who work part time, because annual salaries for part-time or self-employed work are not strictly comparable to full-time salaries. See the chapter 5 Technical Notes for information on how salary and some of the other variables were measured in this analysis.

[15] This analysis uses the 1993 Survey of Doctorate Recipients. It builds on an extensive literature in which the issue of the salary gaps for different populations is examined. See Blau and Ferber (1986) for an overview of literature on the gender salary gap.

[16] To examine the issue of salary equity, we use statistical techniques that permit a more comprehensive approach than is possible using the cross-tabulation approach used in most of this report. These techniques are discussed in the chapter 5 Technical Notes.

Text table 5-2.
“Explained” versus observed gender salary gap for science and engineering doctorate recipients: 1993

	Salary gap	% of observed gap
“Explained by” adjustment factors[a]		
Years since doctorate	$3,200	24.3
Field of degree	1,500	11.2
Other work-related employee characteristics	2,500	18.7
Employer characteristics	1,300	9.9
Type of work	2,000	14.9
Life choices”	1,400	10.6
Total “explained”	$11,900	89.6
Unexplained salary gap	1,400	10.4
Observed salary gap[b]	$13,300	100.0

[a] See the chapter 5 Technical Notes for an explanation of the methodology used in preparing this table.
[b] Average observed male salary: $63,600. Average observed female salary: $50,200.

NOTE: Detail may not add to total because of rounding.

SOURCE: SRS/NSF 1993 Survey of Doctorate Recipients

To determine how much of the $13,300 doctoral gender salary gap could be “explained” by differences between men and women on characteristics expected to affect their salaries, a statistical analysis was performed. This analysis permitted estimation of how large the salary gap would be if men and women in the doctoral labor force were similar on a large number of variables—the year the doctorate was received, science and engineering degree field, other work-related employee characteristics, employer characteristics, type of work performed, and indicators of “life choices.” Together, these variables accounted for an estimated $11,900 of the observed $13,300 difference between the average salary of male science and engineering doctorate-holders and the average salary of female science and engineering doctorate-holders. The variables examined failed to explain the remaining $1,400 of the gap. This residual gap could have a number of possible causes:

- Although most of the important nondemographic factors that one would expect to affect differentially the salaries of men and women doctorate-holders were statistically controlled, it was not possible to control for all such factors.[17] Among the variables that would be interesting to add in the future are
  - measures of productivity, such as the number of books and articles published;[18]
  - prestige of the school or department from which the individual received his or her degree;[19]
  - prestige of the school or department at which employed;[20] and
  - more direct measures of the importance of salary as a factor in job selection.
- The measures of the variables examined are imperfect. Better measures of some of the variables might add to the ability to explain the gender salary gap. For example, 20 categories were used to measure degree fields. Within each of these degree fields, however, the subfields may differ from one another in terms of salary and gender representation.
- The results are also potentially influenced by other types of errors such as sampling error and nonresponse bias that are inherent in sample surveys.[21]
- Some or all of the “unexplained” gender salary gap may be attributable to “unequal pay for equal work.” Indeed, the size of the unexplained gap may even be underestimated. For example, it is possible

[17] See the chapter 5 Technical Notes for a discussion of how variables were selected for inclusion in the final model.

[18] Broder (1993) points out that this is a frequently used measure in the analysis of salary differentials in the academic labor market.

[19] Interestingly, Formby et al. (1993) did not find this variable significant in their analysis of the entry-level salaries of academic economists. Clark (1993), however, found significant impacts of both quality of granting institution and quality of employing institution on salary.

[20] Broder (1993) found an insignificant salary premium for prestige of the university in her sample of economists. Formby et al. (1993), however, found this variable to be highly significant. The type of academic institution, as measured by Carnegie code, is, in part, a measure of prestige; however, there are more refined measures available, though none that were mapped to the 1993 Survey of Doctorate Recipients at the time this analysis was performed.

[21] See *Guide to NSF Science and Engineering Resources* for an overview of the methodology employed in the 1993 Survey of Doctorate Recipients, including possible sources of error.

that chance has led to the inclusion of a disproportionately high percentage of high salaried women in the sample. Further, one can argue that some of the "explanatory" variables included in the analysis should have been excluded. For example, if one believes that the primary reason that women are less likely than men to go into certain fields is a perception that these fields are inhospitable to women, one might argue that field of degree should not be used as an "explanatory" variable when examining the salary gap between men and women.

In the remainder of this section, more detail is presented on the importance of the variables examined in contributing to the explanation of the gender salary gap.

Years Since Receipt of Doctorate

In the earlier chapters of this report, a long-term increase in the percentage of science and engineering doctoral degrees going to women was noted. Although this can be viewed as progress, it also means that women doctorate-holders are, on average, more recent doctorate recipients than are men. In 1993, the average full-time employed woman science and engineering doctorate-holder had received her doctorate approximately 10.4 years ago, compared to the average man who had received his degree approximately 15.7 years earlier. (See appendix table 5-32.) The gender difference in years since receipt of the doctorate "explains" approximately $3,200 of the observed $13,300 salary gap. (See text table 5-2.) This means that the difference in years since receipt of the doctorate accounts for almost one-quarter of the observed gender salary gap.

Field of Degree

Field of degree varies considerably between men and women. Women in the doctoral science and engineering population are disproportionately concentrated in psychology and the social sciences, whereas men are disproportionately represented in physics and engineering (see appendix table 5-32). Because science and engineering degree field is an important determinant of salary for the doctoral population, this variable may be helpful in explaining the gender salary gap. As seen in text table 5-2, it explains approximately $1,500 (11 percent) of the observed gender salary gap.[22]

Background Variables

Several variables on the 1993 Survey of Doctorate Recipients (SDR) that measure attributes of the individual's background prior to degree completion may affect salary. These variables are mother's education, father's education, and whether the individual lived in a rural area during the time he or she was growing up. None of these variables had a statistically significant impact on salary and, therefore, were not included in the final analysis.[23]

Other Work-Related Employee Characteristics

Individuals can, of course, enhance their job skills subsequent to receipt of the doctorate. They can engage in additional educational and training activities, obtain work experience, and participate in professional society activities. The SDR contains a considerable number of relevant measures to use in examining the impact of these variables on the gender salary gap. These include type of additional degrees (e.g., none, M.D., law degree) received since the science and engineering doctorate, whether the individual has taken additional courses since the last degree, the number of years of full-time work experience, whether the individual attended any professional society meetings or conferences within the last year, and the number of national or international professional society memberships.

Other work-related employee characteristics that are included in the SDR and that are associated with salary are age at time the doctorate was received, whether the individual has previously retired,[24] whether the individual has a license related to his or her occupation, whether the individual was employed in 1988, and if so, whether he or she has changed occupations since 1988.[25]

Text table 5-2 shows that these additional employee characteristics add considerably to an understanding of the gender salary gap. Collectively, they explain approximately $2,500 (19 percent) of the gap. Most of this explanatory power (13 of the 19 percentage points) is attributable to differences between men and women in years of full-time work experience. (See appendix table 5-32.) Also worthy of note is that age at time the doctorate was received explains approximately 5 percent of the gap, even though the difference in age between men and women at the time of degree is fairly small (33 years for women compared with 31 for men).

Employer Characteristics

Women science and engineering doctorate-holders are less likely to be employed in the private sector, where salaries are relatively high—21 percent of the

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[22] For the purposes of this presentation, we have included in the broad field of degree category a set of variables that reflect the fact that the effect of years since doctorate on salary is not necessarily the same for all degree fields. These interaction effects explain -9 percent of the salary gap, i.e., equalizing women and men on these interaction variables would lead to an increase in the salary gap. The main effect of field of degree is a 20 percent decrease in the gap. (See appendix table 5-32.)

[23] This methodology is discussed in the chapter 5 Technical Notes.

[24] "Retired" individuals are included in the present analysis only if they were working full time in April 1993.

[25] See the chapter 5 Technical Notes for information on variables excluded from the analysis because there was not a statistically significant relationship.

women in this analysis were employed in this sector compared with 33 percent of the men. (See appendix table 5-32.) We therefore expect differences in the type of employers to help explain the gender salary gap. [26] A second employer characteristic of relevance to salary analysis is the region of the country in which the employer was located—though the differences between men and women on region of employment are small. These two variables accounted for $1,300 (10 percent) of the doctoral gender salary gap.

Type of Work

A number of variables in the SDR permit examination of gender differences in type of work performed. These include occupation, whether the occupation is closely related to the degree received, primary and secondary work activities, whether the position is a management position, the number of employees supervised directly, the number supervised indirectly, and whether the position is a postdoctoral appointment. These variables jointly explain approximately $2,000 (15 percent) of the doctoral gender salary gap. None of the individual variables within this group was responsible for more than 4 percentage points.

Life Choices

The last set of variables consists of those labeled "life choices." Jobs typically entail a number of rewards in addition to salary (such as fringe benefits and prestige) and also entail costs, such as the opportunity costs associated with the time spent on the job. Employers are likely to find that they can offer relatively low salaries to fill positions with high nonsalary rewards or low nonsalary costs. Men and women may place different values on these nonsalary aspects of jobs, and this may result in salary differentials. For example, if, on the average, women place a higher value on having a "short" work week than do men (e.g., because of greater responsibilities for child care), women may be more likely to choose positions with relatively low salaries and fewer work hours per week.[27] Although the SDR does not directly ask individuals to rate the importance of different factors in their job selection, a number of variables on the database are relevant for an understanding of these "life choices."

Variables in the "life choices" set include family-related variables—marital status; whether spouse was working full time, part time, or not at all; and whether spouse had a position requiring at least bachelor's-level expertise in the natural sciences, computer science, or engineering. Also included in this category are reasons related to why individuals took the following actions: worked outside of the field of doctorate, changed occupation or employer between 1988 and 1993, took courses following completion of the most recent degree, and took work-related workshops or other training.

The variables in this group collectively explain $1,400 (11 percent) of the doctoral gender salary gap. Seven of the 11 percentage points were accounted for by marital status (see appendix table 5-32). Women were much less likely than men to be married (63 percent compared with 83 percent); being married had a positive effect on salary.

Summary

In sum, the salary gap is substantial between men and women with science and engineering doctorates, but approximately 90 percent of the observed $13,300 gap can be accounted for by differences between men and women on the variables examined in this analysis. The most important explanatory variable is years since receiving the doctorate, a variable that explains $3,200 of the observed salary gap. A wide variety of employee, employer, and work characteristics also contribute to the explained salary gap. The remaining $1,400 (10 percent of the observed gap) that is not accounted for by the statistical analyses examined in this chapter can be interpreted as an estimate of employer preferences for different types of employees. It is important to recognize, however, that it is, at best, a rough estimate, because statistical models are never able to capture with complete accuracy the true complexity of human behavior.

Minority Scientists and Engineers[28]

With the exception of Asians, minorities are a small proportion of scientists and engineers in the United States. Asians were 9 percent of scientists and engineers in the United States in 1993, although they were only 3 percent of the U.S. population. Blacks, Hispanics, and American Indians as a group were 23 percent of the U.S. population but only 6 percent of the total science and engineering labor force.[29] Blacks and Hispanics were each about 3 percent, and American Indians were less than 1 percent of scientists and engineers. (See figure 5-1.)

Within the doctoral science and engineering labor force, the differences in representation of racial and ethnic groups are greater than is the case within the science

[26] See the chapter 5 Technical Notes for a discussion of how type of employer is measured.

[27] See Barbezat (1992) for an analysis of the relationship between gender and choices among PhD graduate students in economics who were seeking employment in 1988–1989. Most important for the present analysis was her finding that men rated the importance of salary and fringe benefits of prospective employers significantly more highly than did women.

[28] The data reported in this section include both U.S.-born and non-U.S.-born scientists and engineers unless otherwise noted.

[29] The science and engineering field in which blacks, Hispanics, and American Indians earn their degrees has a lot to do with participation in the science and engineering labor force. Blacks, Hispanics, and American Indians are disproportionately likely to earn degrees in the social sciences and to be employed in social science practice, e.g., in social work, clinical psychology, rather than in social sciences per se.

and engineering labor force as a whole. Underrepresented minorities are an even smaller proportion of doctoral scientists and engineers in the United States than they are of bachelor's or master's scientists and engineers. Asians were 11 percent of doctoral scientists and engineers in the United States in 1993. Blacks were 2 percent, Hispanics were 2 percent, and American Indians were less than half of 1 percent of doctoral scientists and engineers. (See appendix table 5-33.)

Field

Within the science and engineering labor force as a whole, the distribution of minority scientists and engineers by field differs depending on the minority group. Asians are concentrated in engineering, in computer science, and in the life and physical sciences. Black scientists and engineers are disproportionately likely to be in the social sciences and in computer science. Hispanics and American Indians do not differ greatly from whites in terms of field. (See appendix table 5-2.)

Minority women, with the exception of Asian women, are similar to white women in terms of field. Black and Hispanic women are more likely than minority men to be in computer or mathematical sciences and in social sciences and are less likely than minority men to be in engineering. Asian women, although less likely than men to be engineers, are more likely than other women to be engineers. Asian women, like Asian men, are less likely than other women to be social scientists. (See appendix table 5-2.)

Black and American Indian scientists and engineers are more likely than white, Hispanic, or Asian scientists and engineers to have a bachelor's as the terminal degree. (See appendix table 5-2.) For example, 66 percent of black scientists and engineers in the U.S. labor force have a bachelor's as the highest degree compared to 55 percent of all scientists and engineers.

Among doctoral scientists and engineers, field differences in employment follow the differences in field of doctorate noted in chapter 4. Black doctoral scientists and engineers are concentrated in the social sciences and are underrepresented in the physical sciences and engineering. Half of black doctoral scientists and engineers, but only 29 percent of all scientists and engineers, are in the social sciences and psychology. Only 11 percent of black doctoral scientists and engineers compared with 21 percent of all doctoral scientists and engineers are in physical sciences, and only 11 percent of black doctoral scientists and engineers, compared with 16 percent of the total, are in engineering. (See appendix table 5-33.) Hispanic doctoral scientists and engineers are similar to whites in terms of field.

Asians are more likely than other doctoral scientists and engineers to be in engineering and are less likely than other doctoral scientists and engineers to be in social science. Thirty-seven percent of Asians are in engineering, compared with 16 percent of all doctoral scientists and engineers, and only 10 percent of Asians are social scientists, including psychologists, compared with 29 percent of all doctoral scientists and engineers. (See text table 5-3.)

Nativity is a large influence on Asians' choice of field. U.S.-born Asians are similar to whites in terms of field. Non-U.S.-born Asians, on the other hand, as well as non-U.S.-born members of other racial/ethnic groups, are disproportionately likely to be engineers. Non-U.S.-born scientists and engineers are about twice as likely as U.S.-born scientists and engineers, no matter what racial or ethnic group, to be engineers. (See appendix table 5-33.)

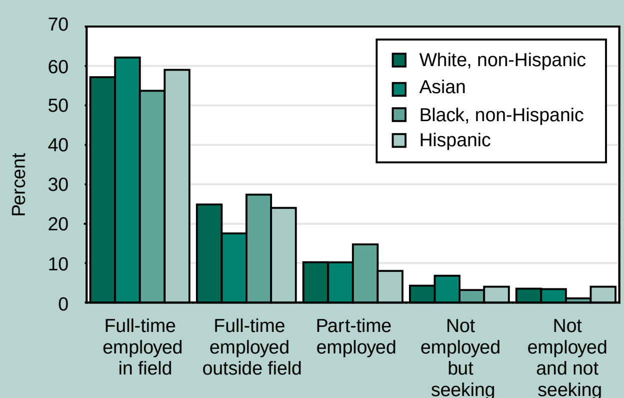
Employment and Unemployment

Bachelor's Scientists and Engineers

Recent minority bachelor's science and engineering graduates differ in their pursuit of postgraduation education as well as their employment status. About 30 percent of new bachelor's graduates pursue graduate study either full time or part time. Among recent bachelor's graduates, Hispanics and Asians are more likely than whites or blacks to go on to graduate school. (See appendix table 5-34.) Differences in degree field do not appear to explain this, because a high proportion of Asian graduates received degrees in engineering and a high proportion of Hispanic graduates received degrees in social sciences. In neither of these fields do a high proportion of graduates pursue graduate education.

Minority bachelor's graduates differ in postgraduation employment status as well. Asian recent graduates are less likely than other groups to be employed outside their field but are more likely to be unemployed. (See figure 5-15.) The unemployment rate for new Asian

Figure 5-15.
Employment status of 1992 bachelor's science and engineering graduates, by race/ethnicity: 1993



See appendix table 5-34.

NOTE: A respondent is employed "in field" if he or she responded that his or her current work is "closely related" or "somewhat related" to degree. Employment status excludes full-time students.

Text table 5-3.
Doctoral scientists and engineers in the labor force, by field of doctorate and race/ethnicity: 1993

All doctoral scientists and engineers
[Percentage distribution]

Field	Total	White, non-Hispanic	Black, non-Hispanic	Hispanic	Asian	American Indian
Total, all fields	100.0	100.0	100.0	100.0	100.0	100.0
Total, science	83.8	86.3	89.4	85.3	62.9	90.4
Physical sciences	21.4	21.4	10.9	19.5	23.6	16.3
Computer and mathematics	6.0	5.7	4.1	7.7	8.2	3.9
Life sciences	26.9	27.8	24.7	23.4	20.9	23.0
Social sciences	29.5	31.3	49.7	34.7	10.1	47.2
Engineering	16.2	13.7	10.6	14.7	37.1	10.1

U.S.-born doctoral scientists and engineers
[Percentage distribution]

Field	Total	White, non-Hispanic	Black, non-Hispanic	Hispanic	Asian	American Indian
Total, all fields	100.0	100.0	100.0	100.0	100.0	100.0
Total, science	87.6	87.4	93.5	90.6	84.0	91.2
Physical sciences	21.3	21.5	10.6	19.3	23.7	15.2
Computer and mathematics	5.5	5.6	3.7	5.2	4.1	4.1
Life sciences	28.3	28.4	25.0	25.0	34.0	22.8
Social sciences	32.4	31.9	54.5	41.2	22.4	49.1
Engineering	12.4	12.6	6.5	9.4	16.0	8.8

See appendix table 5-33.

bachelor's science and engineering graduates is 7 percent, compared with between 3 percent and 4 percent for white, black, and Hispanic graduates. (See appendix table 5-34.)

The types of jobs that new bachelor's science and engineering graduates go into are related to their fields of degree. Graduates with degrees in engineering and the physical sciences are most likely to find employment in science and engineering occupations. Eighty percent or more of full-time employed new bachelor's engineers and physical scientists are employed in their fields, compared with 55 percent of comparable social scientists. (See appendix table 5-34.) Those with degrees in the social sciences are most likely to find employment in non–science-and-engineering occupations that are related to science and engineering. For example, black and Hispanic science and engineering graduates, more than half of whom earned degrees in the social sciences, are more likely than other racial or ethnic groups to be employed in social services. (See figures 5-16 and 5-17.)

Doctoral Scientists and Engineers

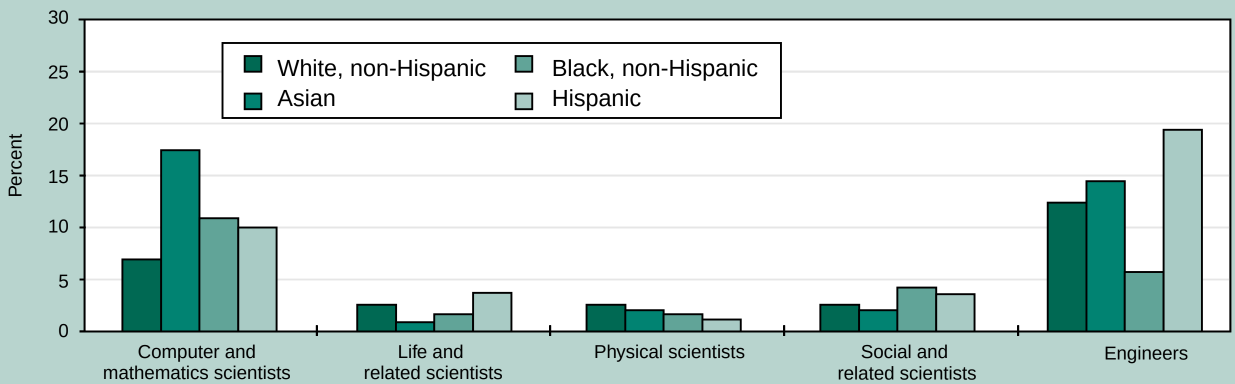
In 1993, unemployment rates of doctoral scientists and engineers by race/ethnicity did not differ significantly. (See appendix table 5-36.) The differences in unemployment were small and were consistent with what is expected from chance variations due to sampling.

Sector of Employment

Racial and ethnic groups differ in employment sector, partly because of differences in field. Among bachelor's and master's scientists and engineers, 60 percent of black, 66 percent of Hispanic, and 69 percent of Asian, compared with 73 percent of white bachelor's scientists and engineers, are employed in business or industry. (See appendix table 5-14.)

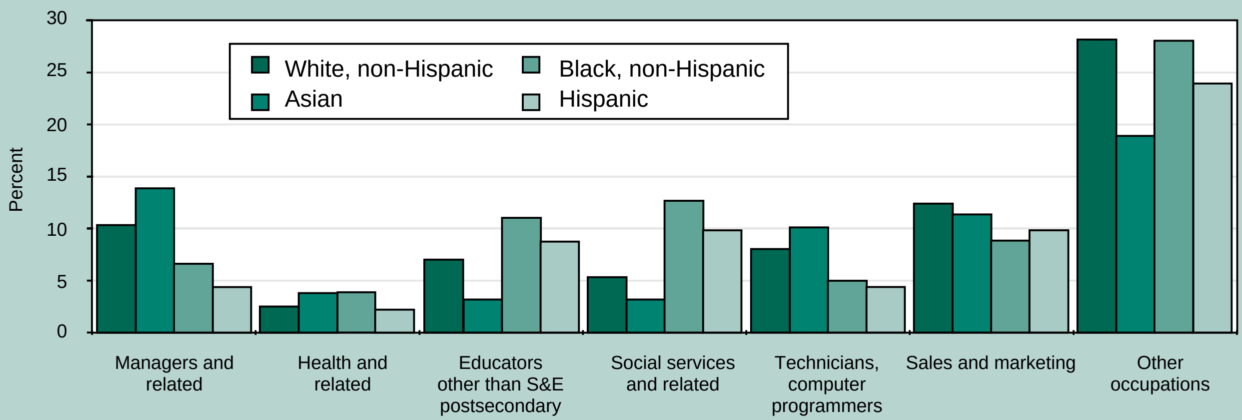
Among doctoral scientists and engineers, blacks, Hispanics, and American Indians are slightly more likely than whites to be employed in colleges and universities and in other educational sectors and are slightly less likely than whites to be employed in business or industry. (See figure 5-18.) Asians differ greatly from all the other racial or ethnic groups. They are less likely to be employed in colleges and universities and are much more likely to be employed in business or industry: 46 percent of Asians compared with 29 percent of whites are employed in industry. Partly, this can be explained by differences in field. Blacks, Hispanics, and American Indians are concentrated in the social sciences, which

Figure 5-16.
Science and engineering occupations of 1992 bachelor's science and engineering graduates, by race/ethnicity: 1993



See appendix table 5-35.

Figure 5-17.
Non–science-and-engineering occupations of 1992 bachelor's science and engineering graduates, by race/ethnicity: 1993



See appendix table 5-35.

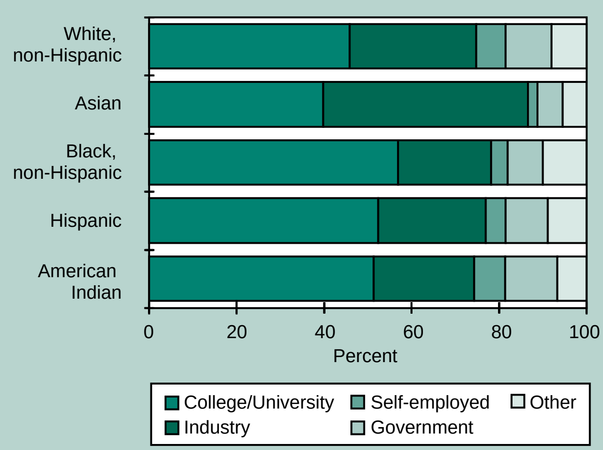
are less likely to offer employment in business or industry, and are underrepresented in engineering, which is more likely to offer employment in business or industry. Asians, on the other hand, are overrepresented in engineering and thus are more likely to be employed by private for-profit employers.

Academic Employment

Racial/ethnic groups differ in field of teaching and in academic employment characteristics. They differ in the types of institutions in which they teach, in employment status, in highest degree, in research activities, in rank, and in tenure.

Blacks are underrepresented and Asians are overrepresented among engineering faculty. Although blacks are 4 percent of science faculty, they are only 2 percent of engineering faculty. Within the sciences, black faculty are a higher proportion of social science faculty (6

Figure 5-18.
Sector of employment of doctoral scientists and engineers in the labor force, by race/ethnicity: 1993



See appendix table 5-16.

percent) than they are of other disciplines. Asians are 15 percent of engineering faculty and 5 percent of science faculty (see figure 5-19).

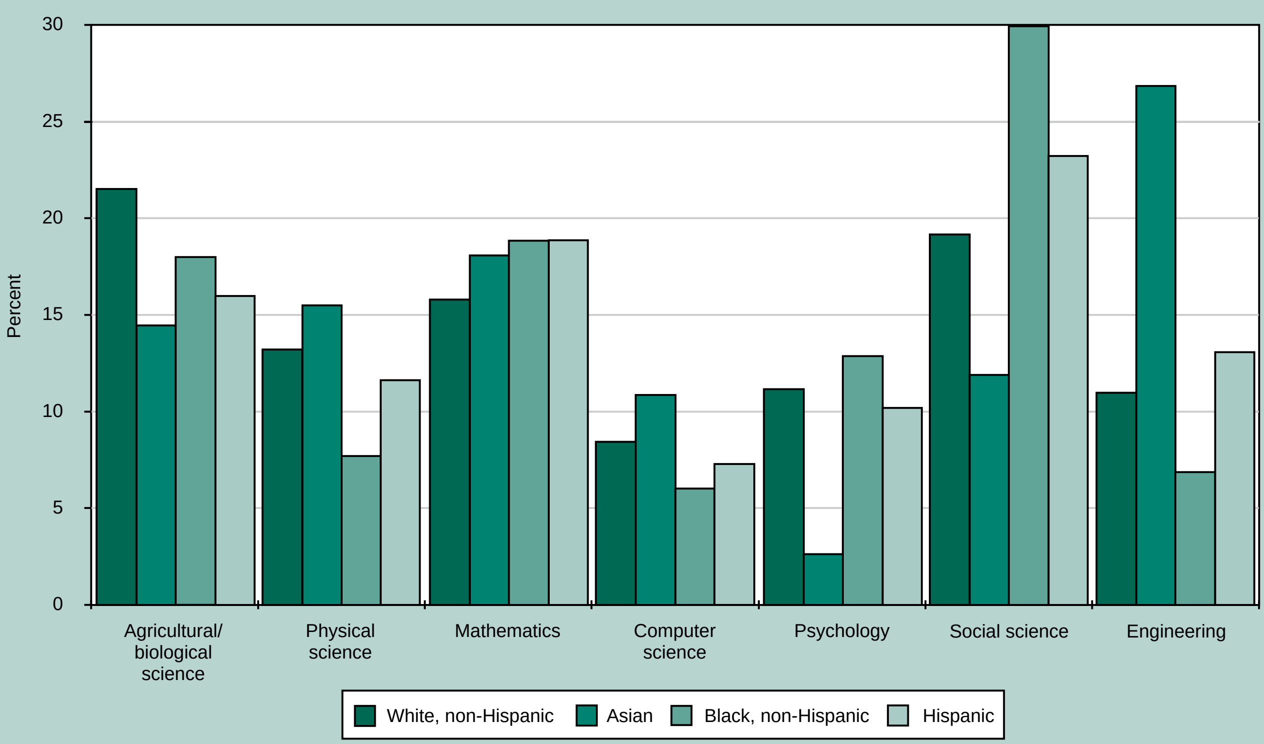
The types of schools in which racial/ethnic groups teach differ. Asian faculty are far less likely than other groups to be employed in 2-year colleges. Black faculty are less likely than other groups to be employed in research institutions and are more likely to be employed in comprehensive institutions, liberal arts schools, and 2-year colleges. (See figure 5-20.) Hispanic faculty are less likely than other groups to be employed in research institutions and are more likely to be employed in 2-year colleges.

Minority faculty also differ in research activities. Asian science and engineering faculty are far more likely than other groups to be engaged in research and to prefer spending time doing research, especially in the doctorate and comprehensive universities. (See appendix table 5-37.) They are also more likely than others to be engaged in funded research, to be principal or co-principal investigators (see appendix table 5-24), and to have published within the last 2 years—at all ages and within research universities. (See appendix table 5-38.)

Black and Hispanic faculty differ little from white science and engineering faculty in time spent in teaching or research and in preferred time in teaching or research. (See appendix table 5-38.) Black faculty, however, have fewer publications than white scientists and engineers in the previous 2 years—at all ages and in all types of schools. (See appendix table 5-37.) Black faculty are also less likely than other groups to be engaged in funded research or to be a principal investigator or co-principal investigator. (See appendix table 5-24.)

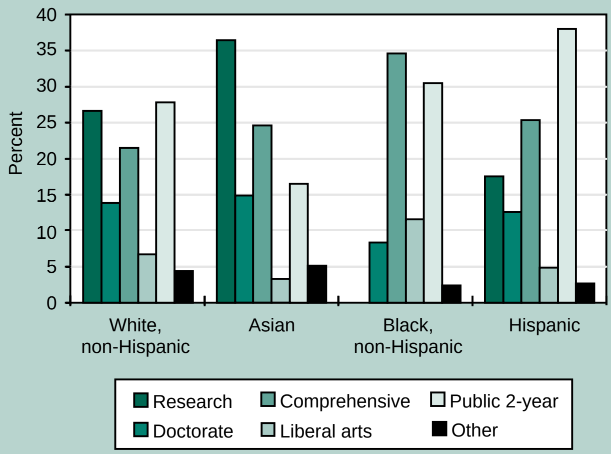
Differences in faculty rank and tenure among racial/ethnic groups exist as well. Although Asians are not underrepresented in science and engineering employment, as is the case with underrepresented minorities, they are less likely to be full professors or to be tenured. Among full-time ranked science and engineering faculty, Asians, blacks, and Hispanics are less likely than whites to be full professors. (See figure 5-21.) Forty-one percent of Asians, 33 percent of blacks, and 45 percent of Hispanics, compared with 49 percent of whites, are full professors. (See appendix table 5-27.) These differences are partly explained by differences in age. Black, Hispanic, and Asian scientists and engineers are younger on average than white and American Indian scientists and engineers. When age differences are accounted for, Asian and Hispanic faculty are as likely or more likely than white faculty to be full professors, but black faculty are still less likely than other faculty to be full professors. Among ranked faculty who received doctorates 13 or more years previously, only 58 percent of black faculty compared to 70 percent of white faculty were full professors. (See appendix table 5-27.)

Figure 5-19.
Distribution of science and engineering faculty by field and race/ethnicity: 1993



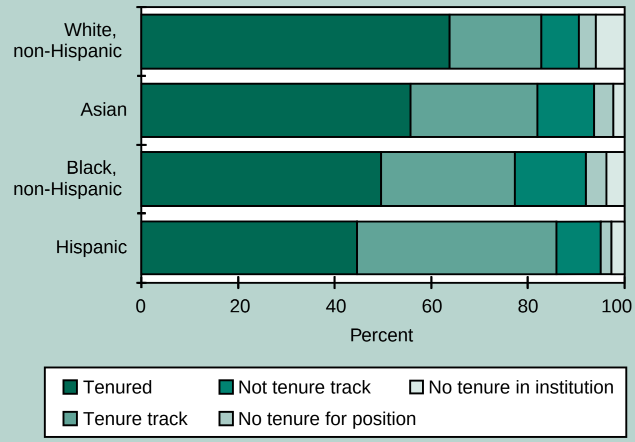
See appendix table 5-18.

Figure 5-20.
Distribution of science and engineering faculty, by type of school and race/ethnicity: 1993



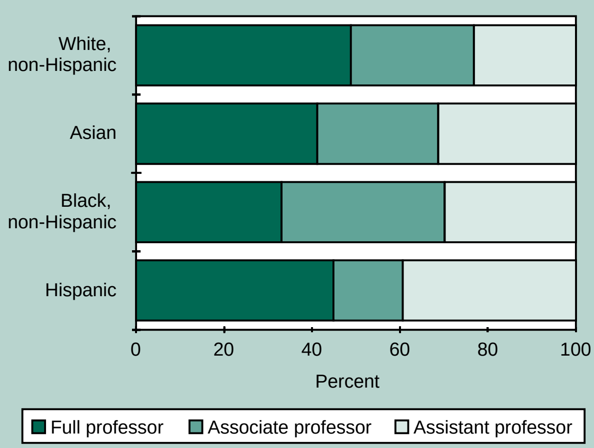
See appendix table 5-19.

Figure 5-22.
Tenure status of full-time science and engineering faculty, by race/ethnicity: 1993



See appendix table 5-28.

Figure 5-21.
Academic rank of full-time ranked science and engineering faculty, by race/ethnicity: 1993



See appendix table 5-27.

Black, Hispanic, and Asian faculty are also less likely than white faculty to be tenured. (See figure 5-22.) Fifty-four percent of black faculty, 52 percent of Hispanic faculty, and 57 percent of Asian faculty, compared with 64 percent of white faculty, are tenured. Black, Hispanic, and Asian faculty are more likely than white faculty to be on a tenure track. Thirty percent of black faculty, 48 percent of Hispanic faculty, and 27 percent of Asian faculty, compared with 19 percent of white faculty, are on a tenure track. (See appendix table 5-28.) Again, these tenure differences are likely to be related to age differences.

Nonacademic Employment

As mentioned previously in this chapter, the majority of both bachelor's and master's scientists and engineers are employed in business or industry. Within business and industry, they are most likely to have computer applications, research and development, and management as their primary work activity. Black, Hispanic, and Asian bachelor's and master's scientists and engineers differ little from white bachelor's and master's scientists and engineers in their primary work activity. For example, 8 percent of both white and black bachelor's scientists and engineers and 9 percent of Hispanic bachelor's scientists and engineers work in applied research. Ten percent of black, 11 percent of Hispanic, and 12 percent of white bachelor's scientists and engineers are in management and administration. (See appendix table 5-39.)

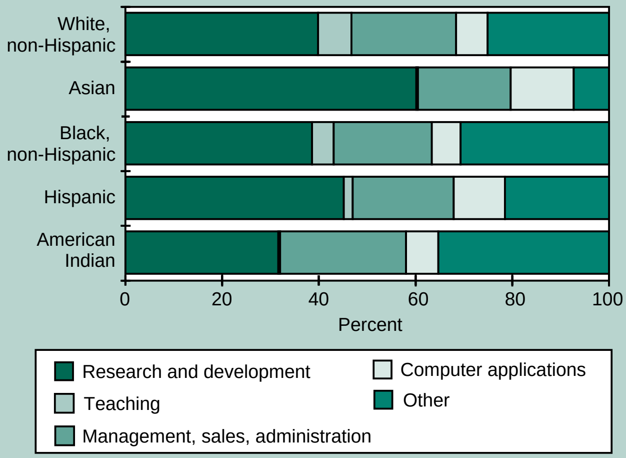
A similar pattern of primary work activity is found among doctoral scientists and engineers. Black and Hispanic doctoral scientists and engineers employed in business or industry have primary work activities similar to white doctoral scientists and engineers. (See figure 5-23.) Asians, on the other hand, are much more likely than other groups to be in research and development.

Salaries

Starting Salaries

In science and engineering, the median starting salaries of new bachelor's and master's science and engineering graduates by race/ethnicity are not dramatically different. (See text table 5-4.)

Figure 5-23.
Primary work activity of doctoral scientists and engineers in industry, by race/ethnicity: 1993



See appendix table 5-40.

Doctoral Racial/Ethnic Salary Gaps

An analysis of the differences in average salaries among racial/ethnic groups was performed analogous to that done for the gender salary gap among full-time employed science and engineering doctorate-holders.[30] Because of the relatively small number of individuals within some of the racial/ethnic groups, the results are necessarily more tentative than was the case for the gender salary gap.

The salary differences between whites and the racial/ethnic minority groups are not as large as the gender salary gap. (See text table 5-5.) The differences range from $4,100 for Asians to $7,100 for blacks. Although smaller than the $13,300 gender gap, these are not trivial differences and rightly raise the question of the extent to which these differences can be accounted for by other variables in a manner analogous to that done for the gender salary gap.

The background variables, including years since receipt of the doctorate and field of degree, explain substantial parts of the observed black/white and Hispanic/white salary gaps (35 percent and 33 percent, respectively). Adding the remaining work-related and life-choice variables to the analysis explains the remaining racial/ethnic salary gaps for blacks and Hispanics.

The analysis of the Asian/white gap shows a very different pattern than that for blacks and Hispanics. Field of degree has a strong "negative" explanatory effect on the salary gap. This indicates that when Asians and whites are statistically "equalized" on field of degree, the resulting salary gap is larger than the observed gap. This is attributable to the fact that Asians are concentrated in degree fields such as engineering that have relatively high salary levels. Employer characteristics also have a strongly negative explanatory effect. This effect largely results from Asians being relatively more likely to be employed in the private sector (47 percent of Asians are so employed compared with 29 percent of whites). (See appendix table 5-41.) After statistically equalizing Asians and whites on all variables in the analysis, the "unexplained" salary gap between Asians and whites is approximately $900 (23 percent of the observed gap).

The salary gap for American Indians and whites shows an explanatory pattern that is different from the other groups examined. The data do not indicate that American Indians have been increasing their participation in the doctoral labor force over time. Therefore, years since doctorate is not an important factor in explaining the salary gap between American Indians and

Text table 5-4.
Median annual salaries of full-time employed 1992 bachelor's and master's science and engineering graduates, by broad occupation and race/ethnicity

Race/ethnicity	Bachelor's		Master's	
	Total scientists	Total engineers	Total scientists	Total engineers
Total	$26,000	$33,500	$35,000	$40,600
White, non-Hispanic	25,200	33,000	35,800	41,200
Black, non-Hispanic	27,500	36,400	26,000	41,800
Hispanic	26,200	32,000	29,000	40,200
Asian	28,000	35,000	35,000	38,500

NOTE: Excludes full-time graduate students.

SOURCE: National Science Foundation, National Survey of Recent College Graduates, 1993.

[30] The methodological approach used in analyzing salary gaps is discussed in the section on gender salary gaps and in more detail in the chapter 5 Technical Notes.

Text table 5-5.
"Explained" versus observed race/ethnic salary gaps for science and engineering doctorate recipients: 1993

	Blacks (compared with whites)		Hispanics (compared with whites)		Asians (compared with whites)		American Indians (compared with whites)	
	Salary gap	% of observed gap	Salary gap	% of observed gap	Salary gap	% of observed gap	Salary gap	% of observed gap
"Explained by" adjustment factors[a]								
Years since doctorate	$2,300	32.5	$2,500	44.0	$2,700	65.2	$100	1.9
Field of degree	200	2.9	(600)	–10.9	(2,600)	–62.3	900	13.3
Other work-related employee characteristics	2,100	29.4	2,300	39.2	3,500	84.5	0	–0.0
Employer characteristics	2,500	34.7	900	16.4	(2,600)	–63.1	2,800	43.5
Type of work	(100)	–1.2	700	12.6	2,300	55.6	100	1.4
"Life choices"	700	9.8	100	2.1	(100)	–3.3	(200)	–2.8
Total "explained"	$7,700	108.0	$5,900	103.3	$3,200	76.6	$3,700	57.3
Unexplained salary gap	(600)	–8.0	(100)	–3.3	900	23.4	2,800	42.7
Observed salary gap[b]	$7,100	100.0	$5,800	100.0	$4,100	100.0	$6,500	100.0

[a] See the chapter 5 Technical Notes for an explanation of the methodology used in preparing this table.
[b] Average observed white salary: $61,700; black salary: $54,600; Hispanic salary: $56,000; Asian salary: $57,600; American Indian salary: $55,200.

NOTE: Detail may not add to total because of rounding.

SOURCE: SRS/NSF 1993 Survey of Doctorate Recipients

whites. All of the variables combined explain approximately 57 percent of the $6,500 salary gap. Thus, approximately 43 percent of the observed gap remains unexplained. For American Indians, this constitutes approximately $2,800. The reader is cautioned, however, that the number of American Indians in the sample is quite small and that these estimates must be considered fairly imprecise.[31]

Before leaving the topic of racial/ethnic salary differences, it is interesting to look at whether significant "unexplained" racial/ethnic salary gaps are evident when one looks separately at U.S.-born and non-U.S.-born individuals, since a disproportionately high percentage of minority group members in the doctoral population are born outside the United States and the decomposition of the salary gaps for U.S.-born individuals could be quite different than for those born outside of this country. Examination of the data indicates that for U.S.-born individuals, the variables examined "explain" all or almost all of the observed racial/ethnic salary gaps for all the groups examined except for American Indians. (See text table 5-6.) In fact, U.S.-born blacks and Asians have higher average salaries than would be expected, given the different racial/ethnic group characteristics on the variables examined, when compared with whites.

The relatively high salaries of U.S.-born blacks and Asians may, of course, be the result of imperfections in the model used in this analysis. It is possible, for example, that the obstacles placed in the way of minority entry into the doctoral science and engineering labor force result in those minority members who are successful being more qualified than whites on factors, such as "willingness to work hard," that we were unable to measure. Alternately, the relatively high salaries of U.S.-born blacks and Asians may indicate that employers have a preference for U.S.-born blacks and Asians—perhaps in response to affirmative action programs.

Among the non-U.S.-born, Hispanics have similar salaries to whites with similar characteristics; however, approximately $2,300 of the Asian/white and black/white gaps remain unexplained.[32]

In sum, these data do not indicate that racial/ethnic status has much effect on salary within this very "elite"

[31] A regression analysis incorporating the demographic variables indicated that the difference between American Indians and other racial/ethnic groups could be explained by chance.

[32] Including an interaction effect between race/ethnicity and place of birth indicates the interaction is statistically significant at the 0.05 level. See the chapter 5 Technical Notes for more information on this analysis.

Text table 5-6.

“Explained” versus observed race/ethnic salary gaps for science and engineering doctorate recipients, by birthplace: 1993

	U.S.-born								Non-U.S.-born					
	Blacks (compared with whites)		Hispanics (compared with whites)		Asians (compared with whites)		American Indians (compared with whites)		Blacks (compared with whites)		Hispanics (compared with whites)		Asians (compared with whites)	
	Salary gap	% of observed gap	Salary gap	% of observed gap	Salary gap	% of observed gap	Salary gap	% of observed gap	Salary gap	% of observed gap	Salary gap	% of observed gap	Salary gap	% of observed gap
“Explained by” adjustment factors[a]														
Years since doctorate	$1,800	34.9	$2,000	30.1	$2,300	90.4	$200	3.3	$2,500	22.1	$2,100	46.4	$1,500	34.3
Field of degree	700	14.3	100	1.9	(600)	–21.4	900	12.3	300	2.5	(200)	–5.3	(1,200)	–27.6
Other work-related employee characteristics	1,300	26.1	1,600	23.6	2,000	79.1	100	1.3	2,600	22.5	1,800	39.9	2,100	48.8
Employer characteristics	2,900	57.1	2,200	32.5	(2,200)	–84.0	2,900	40.8	2,100	18.3	(100)	–2.1	(2,000)	–45.8
Type of work	(900)	–17.3	400	6.6	1,500	57.8	100	2.0	1,200	10.1	600	13.5	1,800	42.4
“Life choices”	900	17.0	0	0.5	600	22.7	(200)	–2.3	400	3.5	300	6.7	(100)	–2.8
Total “explained”	$6,700	132.1	$6,400	95.2	$3,700	144.6	$4,000	57.4	$9,100	79.1	$4,400	99.1	$2,100	49.3
Unexplained salary gap	(1,700)	–32.1	400	4.8	(1,100)	–44.6	3,000	42.6	2,400	20.9	100	0.9	2,200	50.7
Observed salary gap[b]	$5,000	100.0	$6,800	100.0	$2,600	100.0	$7,000	100.0	$11,500	100.0	$4,500	100.0	$4,300	100.0

[a] See the chapter 5 Technical Notes for an explanation of the methodology used in preparing this table.

[b] For U.S.-born individuals, average observed white salary: $61,700; black salary: $56,700; Hispanic salary: $55,000; Asian salary: $59,100; American Indian salary: $54,700 . For non-U.S.-born individuals, average observed white salary: $61,800; black salary: $50,300; Hispanic salary: $57,300; Asian salary: $57,500.

NOTE: Detail may not add to total because of rounding.

SOURCE: SRS/NSF 1993 Survey of Doctorate Recipients population of full-time-employed individuals with doctoral science and engineering degrees when one compares groups with similar characteristics on relevant variables. After adjusting for differences in work-related characteristics, the only U.S.-born minority group with an average salary substantially lower than that of U.S.-born whites was American Indians. Because the sample contains few American Indians, however, this result may be attributable to sampling variability. For U.S.-born blacks and Asians, minority group salaries are actually somewhat higher than would be expected on the basis of the characteristics adjusted for in this analysis.

Scientists and Engineers With Disabilities

Persons with disabilities are also underrepresented in science and engineering. Comparisons of data on participation of persons with disabilities are difficult because of differences in definition.[33] It appears, however, that persons with disabilities are a smaller proportion of the science and engineering labor force than they are of the labor force in general. About 20 percent of the population have some form of disability; about 10 percent have a severe disability.[34] Persons with disabilities are 13 percent of all employed persons[35] and about 5 percent of the science and engineering labor force (see figure 5-1).

Doctoral scientists and engineers with moderate to severe disabilities make up about 5 percent of doctoral scientists and engineers in the United States. (See appendix table 5-42.) The proportion of scientists and engineers with disabilities increases with age. More than half became disabled at age 35 or later. Only 7 percent had been disabled since birth, and only one-fourth had been disabled before the age of 20. (See appendix table 5-43.)

The representation of persons with disabilities in the science and engineering population can be estimated by comparing the results of the NSF National Survey of College Graduates with similar results from the Bureau of the Census's Survey of Income and Program Participation.[36] Comparisons of the two survey results indicate that persons with significant sensory-motor disabilities are underrepresented among scientists and engineers. The Survey of Income and Program Participation found that in 1991–1992, 0.4 percent of the general population of 15-to-64-year-olds reported that they were unable to see words and letters. The comparable figure from the 1993 National Survey of College Graduates was 0.1 percent. In the total population, 0.2 percent were unable to hear normal conversations, compared with 0.02 percent of the scientists and engineers, and 1.9 percent of the general population reported being unable to lift a 10-pound bag of groceries, compared with 0.2 percent of the scientists and engineers. For those unable to climb stairs, the total population rate was 2.2 percent compared with 0.2 percent of the scientists and engineers.[37] [38]

Field of Science and Engineering

Unlike women and minorities, persons with disabilities are not particularly concentrated in certain fields (see figure 5-24), although a somewhat higher fraction of those with doctorate degrees in the social sciences have disabilities (6.6 percent) than is true of those with doctorate degrees in science and engineering as a whole (5 percent).

Employment and Unemployment

Recent Bachelor's Graduates

Recent bachelor's science and engineering graduates with disabilities are somewhat less likely than those without disabilities to enroll either full time or part time in graduate school. Twenty-six percent of 1992 bachelor's science and engineering graduates with disabilities were full-time or part-time graduate students in 1993, compared with 31 percent of comparable graduates without disabilities. (See appendix table 5-34.)

[33] The data on persons with disabilities in science and engineering are seriously limited for several reasons. First, operational definitions of "disability" vary and include a wide range of physical and mental conditions. Different sets of data use different definitions and thus are not totally comparable. (See appendix table 1-1.) Second, data about disabilities are frequently not included in comprehensive institutional records (e.g., in registrars' records in institutions of higher education). The third limitation on information on persons with disabilities gathered from surveys is that it often is obtained from self-reported responses. Typically, respondents are asked if they have a disability and to specify what kind of disability it is. Resulting data, therefore, reflect individual decisions to self-identify, not objective measures. Finally, data users should understand that sample sizes for the population of disabled persons may be small and care should be taken in interpreting the data.

[34] Estimates of the proportion of the population with disabilities vary due to use of different definitions of "disability." See appendix A Technical Notes for a discussion of the limitations of estimates of the size of this group. The source of these estimates is the U.S. Department of Commerce, Bureau of the Census. 1993. *Americans With Disabilities: 1991–92: Data from the Survey of Income and Program Participation* (P70-33).

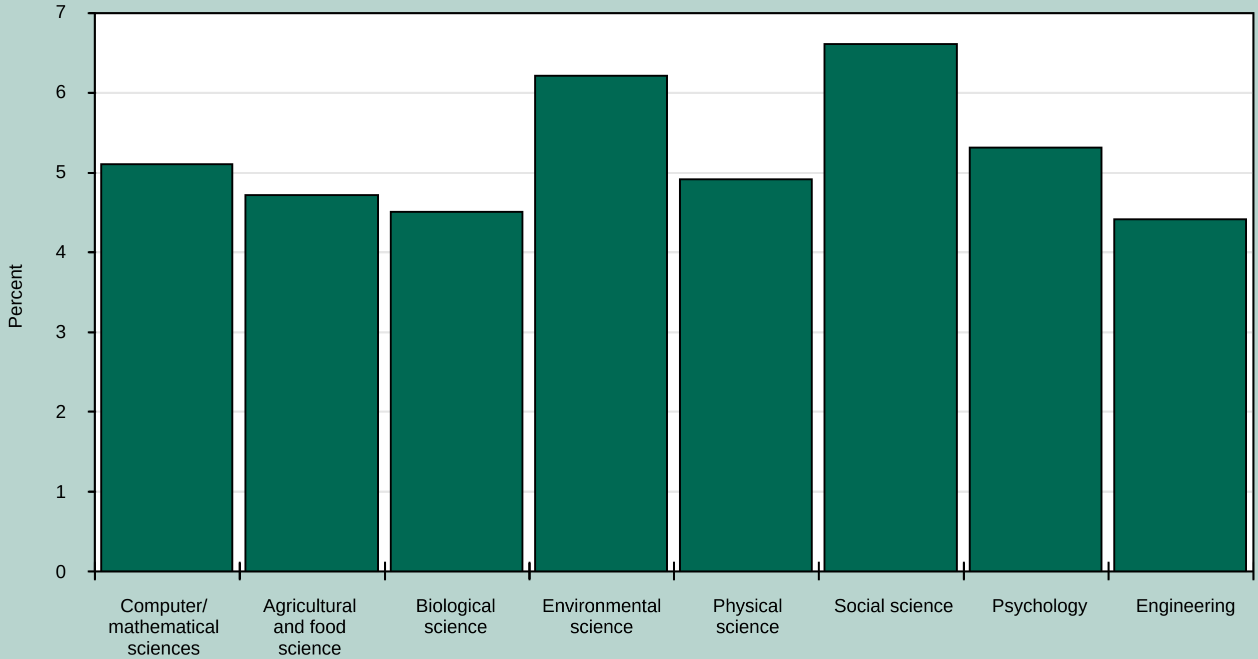
[35] U.S. Department of Commerce, Bureau of the Census. 1994. "Americans With Disabilities" (Statistical Brief SB/94-1).

[36] Because of several differences between the two surveys, comparisons can be made only for certain segments of the two populations.

[37] The question used in the National Survey of College Graduates combined stair climbing and walking, whereas the Survey of Income and Program participation asked about these two activities separately. The rate reported for the latter survey is for the activity with the higher reported disability rate.

[38] Small cell sizes restrict the analysis of types of disability to overall percentages of the science and engineering population.

Figure 5-24.
Persons with disabilities as a percentage of doctoral scientists and engineers in the labor force, by field of doctorate: 1993



See appendix table 5-42.

The unemployment rates of recent bachelor's science and engineering graduates with and without disabilities are similar. The unemployment rate for 1992 bachelor's science and engineering graduates with disabilities was 4.7 percent compared with 4.5 percent for those without disabilities. (See appendix table 5-34.)

Doctoral Scientists and Engineers

The labor force participation rates of doctoral scientists and engineers with and without disabilities are quite different. Almost one-quarter of doctoral scientists and engineers with disabilities are out of the labor force, compared with only 7 percent of those without disabilities. (See appendix table 5-36.) Among those in the labor force, persons with disabilities are more likely than those without disabilities to be unemployed or to be employed part time. The unemployment rate for doctoral scientists and engineers with disabilities was 2.4 percent compared with 1.6 percent for those without disabilities. The percentage of doctoral scientists and engineers in the labor force who were employed part time in 1993 was 11 percent for those with disabilities and 6 percent for those without disabilities. The lack of full-time employment may be particularly problematic for scientists and engineers with disabilities because those who are unemployed or employed part time are likely to have less access to health insurance.

Sector of Employment

Scientists and engineers with disabilities do not differ greatly from those without disabilities in terms of employment sector. Among bachelor's scientists and engineers, 68 percent of persons with disabilities are employed in business or industry, compared with 72 percent of those without disabilities. (See appendix table 5-14.) Among doctoral scientists and engineers, 27 percent of those with disabilities compared with 31 percent of those without disabilities are employed in business or industry. (See figure 5-25.) The fraction of doctoral scientists and engineers with disabilities who are self-employed is higher (9 percent) than the fraction of all doctoral scientists and engineers who are self-employed (6 percent).

Academic Employment

Doctoral scientists and engineers who are employed in universities and 4-year colleges and who have disabilities are more likely than those without disabilities to be full professors and to be tenured. (See figures 5-26 and 5-27.) This can be explained by differences in age. Because incidence of disability increases with age, scientists and engineers with disabilities tend to be older and to have more years of professional work experience than those without disabilities. Eighty-four percent of doctoral scientists and engineers with disabilities are pre-1985 graduates, compared to 67 percent of those

Measuring Disabilities for Persons in the Labor Force

As noted in chapter 1, there is no consensus on the definition of disabilities. This means that in examining statistics related to disabilities, it is necessary to understand the definition used in compiling the statistics.

The decennial census has two relevant questions on work-related disabilities. Individuals are considered to have a disability if they answered "yes" to the question, "Does [the person under discussion] have a physical, mental, or other health condition that has lasted for 6 or more months and which limits the kind or amount of work [the person] can do at a job?" or "yes" to a similar question indicating that the disability made the person unable to work. This definition is not adequate for current purposes for two reasons. First, individuals with what are usually regarded as significant disabilities may respond that they do not have a work disability if they regard their work as being consistent with their education and other skills. This is especially important in understanding the representation of those with disabilities in science and engineering fields, because the work is primarily intellectual. With appropriate accommodation, individuals with significant disabilities that impair their sensory functions or mobility can be highly productive and may not regard themselves as having a disability that affects their ability to work. Second, the measure does not distinguish among types of disabilities. Some disabilities (e.g., disabilities that significantly impair mental functioning) would preclude individuals from attaining the necessary skills for science and engineering employment. It is important, though not always easy, to distinguish between those with disabilities that cannot be accommodated within the science and engineering labor force and those with disabilities that can be accommodated.

To address the problems with the Census Bureau's definition of disabilities, NSF's surveys use a functional definition of disability patterned after one developed for a planned survey of individuals with disabilities developed by the Census Bureau. This measure is based on asking individuals, "What is the USUAL degree of difficulty you have with [specific tasks involving seeing, hearing, walking, and lifting]?[39] Respondents are given five choices for each response, ranging from "none" to "unable to do." Unless elsewhere noted, having a disability is defined as having at least moderate difficulty in performing one or more of these tasks. Although this definition was designed to provide a relatively objective measure of disability, it is important to note that not all disabilities are captured by this measure. For example, learning disabilities and behavioral disorders are not included.[40]

The 1991–92 Survey of Income and Program Participation (SIPP) used questions for measuring disability that are quite similar to those in the Survey of Doctorate Recipients (McNeil 1993). This provides an opportunity to make some approximate comparisons between the science and engineering doctoral population and the larger population.

[39] The full wording of these alternatives in the survey forms is "SEEING words or letters in ordinary newsprint (with glasses/contact lenses if you usually wear them)," "HEARING what is normally said in conversation with another person (with hearing aid, if you usually wear one)," "WALKING without assistance (human or mechanical) or using stairs," "LIFTING or carrying something as heavy as 10 pounds, such as a bag of groceries."

[40] Additional measures of types of disability were omitted from the surveys due to practical limitations. The disability questions included in the questionnaires were considered burdensome and intrusive by many respondents. The surveys designers were concerned that additional questions in this area would have a serious negative impact on the overall response rates and the validity of the survey. This would be especially true if the surveys requested information on highly sensitive disabilities.

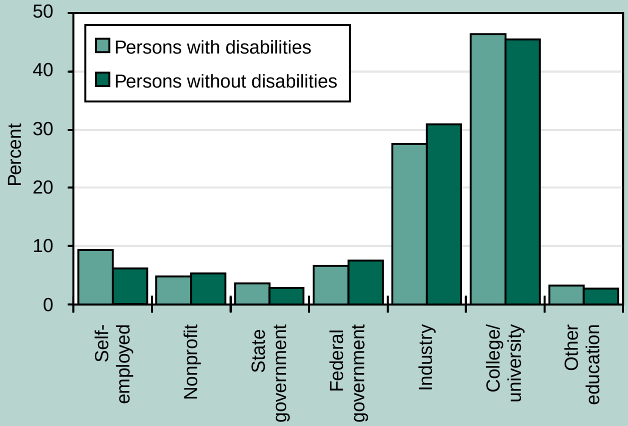
without disabilities. (See appendix table 5-44.) Among pre-1985 graduates, the differences in rank and tenure status between persons with disabilities and persons without disabilities are narrower. For example, 59 percent of doctoral scientists and engineers with disabilities who received their doctorate prior to 1985 are full professors compared with 54 percent of comparable doctoral scientists and engineers without disabilities. (See appendix table 5-44.)

Nonacademic Employment

The type of work that bachelor's-level and master's-level scientists and engineers with disabilities do is not greatly different from the type of work done by those without disabilities. The primary work activity of 27 percent of bachelor's scientists and engineers with disabilities is computer applications, compared with 29 percent of those without disabilities. Design of equipment is the primary work activity of 15 percent of bachelor's scientists and engineers both with and without disabilities. Ten percent of bachelor's scientists and engineers with disabilities and 11 percent of those without disabilities are in management and administration. (See appendix table 5-39.)

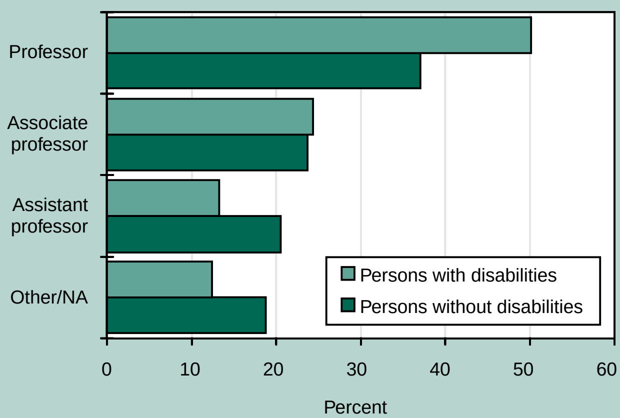
Among doctoral scientists and engineers, those with disabilities are more likely than those without disabilities to be in management. (See appendix table 5-45.) Doctoral scientists and engineers with disabilities are

Figure 5-25.
Sector of employment of doctoral scientists and engineers in the labor force, by disability status: 1993



See appendix table 5-16.

Figure 5-26.
Academic rank of doctoral scientists and engineers in universities and 4-year colleges, by disability status: 1993



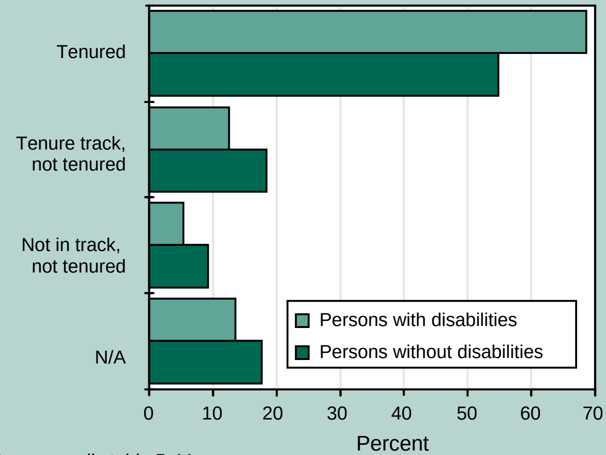
See appendix table 5-44.

older, on average than those without disabilities and thus are more likely to be in management. Among doctoral scientists and engineers age 45 and older and employed in business or industry, 32 percent of both those with disabilities and those without disabilities are in management. (See appendix table 5-45.)

The Disability Salary Gap

The Survey of Doctorate Recipients also permits an examination of the salary gap between persons with and without disabilities, comparable to that done for gender and racial/ethnic groups.[41] For the purpose of this

Figure 5-27.
Tenure status of doctoral scientists and engineers in universities and 4-year colleges, by disability status: 1993



See appendix table 5-44.

analysis, individuals who were disabled by the time of receiving their doctorate degrees were differentiated from those who became disabled subsequent to receiving the degree.[42] This differentiation reflects the fact that the challenges faced by individuals who become disabled after earning their degrees may be different from the challenges faced by individuals who acquire a disability earlier in life.

The observed salary gaps between individuals with disabilities and those without were indeed quite different for those who had disabling conditions at the time of degree and for those who became disabled at a later point. Those in the first group had average salaries approximately $1,600 lower than those without disabilities, whereas those in the latter group had salaries that were $5,700 higher than those without disabilities. (See text table 5-7.) Individuals with late-acquired disabilities, however, are also considerably older than individuals without disabilities. The average length of time since receiving the doctorate was 22 years for those disabled after receiving a degree compared to 14 years for those without a disability and 15 years for those who had a disability by the time they received their doctorates. (See appendix table 5-32.) Adjusting for this difference in time since receipt of the degree explains almost all (85 percent) of the salary advantage of those with late-acquired disabilities compared to those without disabilities.

[41] The methodological approach used in analyzing salary gaps is discussed in the section on gender salary gaps and in more detail in the chapter 5 Technical Notes.

[42] See the box on page 86 for the definition of disability used here. Note that it would be possible to classify individuals by the type of their disability (seeing, hearing, walking, lifting) instead of by the age at which they became disabled, but small sample sizes precluded our using both classifications simultaneously. A regression analysis including both type of disability and age of disability indicated that age of disability was the more important determinant of salary.

Text table 5-7.
“Explained” versus observed salary gap for science and engineering doctorate recipients with disabilities compared with persons without disabilities: 1993[a]

	Disability before PhD		Disability after PhD	
	Salary gap[a]	% of observed gap	Salary gap	% of observed gap
“Explained by” adjustment factors[b]				
Years since doctorate	($400)	85.2	($4,800)	85.2
Field of degree	200	13.2	1,000	-18.3
Other work-related employee characteristics	(600)	-35.6	(3,000)	53.6
Employer characteristics	1,100	69.6	1,400	-25.2
Type of work	0	-0.2	(1,200)	20.6
“Life choices”	100	5.0	(300)	4.7
Total “explained”	$400	24.2	($6,800)	120.5
Unexplained salary gap	1,200	75.8	1,100	-20.5
Observed salary gap[c]	$1,600	100.0	($5,700)	100.0

[a] “Salary gap” is equal to difference from average salary for individuals without disabilities. The negative gap for those with disabilities acquired after the doctorate reflects the fact that the average salary of those with disabilities acquired after the doctorate is higher than the average salary for those without disabilities.
[b] See the chapter 5 Technical Notes for an explanation of the methodology used in preparing this table.
[c] Average observed salary for persons without disabilities: $60,800; average observed salary for those with a disability at time of the doctorate: $59,200; average observed salary for persons acquiring a disability after doctorate: $66,500.

NOTE: Detail may not add to total because of rounding.

SOURCE: SRS/NSF 1993 Survey of Doctorate Recipients.

Other work-related employee characteristics also explain a substantial part (54 percent) of the salary gap between those with late-acquired disabilities and those without disabilities. Most of this difference is attributable to differences between the two groups in the number of years of full-time work experience. (See appendix table 5-32.)

After all of the variables included in the analysis are controlled for, unexplained salary gaps of approximately $1,100 are observed for both groups of persons with disabilities when compared with those without disabilities. Thus, among individuals with doctoral degrees in science and engineering, this rough estimate of the salary disadvantage of having a disability appears to be similar in size to the salary disadvantage of being female.

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Technical Notes
Decomposition of Salary Gaps[43]

Introduction

To examine the issue of salary equity, statistical techniques are used that permit a more comprehensive approach than is possible using the cross-tabulation approach used in most of this report. Although these techniques are widely used in the scientific literature in analyzing similar issues, it should be noted that the techniques used do have some disadvantages when compared with the cross-tabulation approach. Most important, they require the researcher to make a number of "simplifying assumptions." If these assumptions are correct (or approximately correct), the estimates of the salary gaps "explained" by differences in group characteristics are likely to be superior to those obtained by examining cross-tabulations. If the assumptions are far from being correct, however, the researcher may end up with conclusions that are erroneous.

Sample

Data from the 1993 Survey of Doctorate Recipients (SDR) were used in the decomposition of salary gaps in chapter 5. Part-time employees and self-employed individuals were excluded from the analysis, because salary data for these individuals are not likely to be comparable to those for individuals who are employed full time. Approximately 31,100 cases were usable for the analysis.

Basic Statistical Methodology

The first step in the analysis of the salary gaps was to fit a single least-squares regression equation to the total eligible sample, using log salary as the dependent variable and using as independent variables a large number of variables from the SDR. The demographic variables of interest (gender, race/ethnicity, whether U.S.-born, and disability status) were excluded from the equation. Those independent variables that did not have a statistically significant relationship with salary (at the 0.001 level) were deleted from further consideration at this stage.[44] This relatively high level for exclusion was selected, primarily because the large sample size resulted in a large array of statistically significant variables. Even at this conservative level, the number of variables retained makes comprehension of the model difficult.[45]

The parameters of the reduced regression equation were used to decompose the salary gaps of interest, using a modification of the Oaxaca (1973) methodology frequently used for decomposing salary gaps. In this revised methodology, the proportion of a salary gap explained is considered to be equal to:

$$b_t(\overline{X}_1\text{-}\overline{X}_2)$$

where b_t is the vector of parameters from the reduced regression equation, $\overline{X}_1$ is the vector of means for the nonminority group of interest (i.e., men, whites, U.S.-born whites, non-U.S.-born whites or persons without disabilities) and $\overline{X}_2$ is the vector of means for the corresponding minority group of interest.

Current Methodology Compared With Alternate Approaches

The current methodology deviates from the Oaxaca methodology in the selection of the regression equation used for standardization. We have standardized to the regression equation for the total population, whereas the most common application of the Oaxaca methodology is to standardize to the equation for the nonminority group (i.e., using b_1 instead of b_t in the above equation).

We opted to use the regression equation for the total population rather than the nonminority group for three reasons. First, using the total population is consistent with the null hypothesis that no discrimination on the basis of demographic characteristics occurs; this is, of course, the primary null hypothesis of interest.[46] Second, when multiple overlapping groups are considered (i.e., groups based on gender, race/ethnicity, birthplace, and disability status), the Oaxaca approach is conceptually more confusing than that adopted. Do we, for example, use the regression coefficients for men when comparing women with men and use the regression coefficients for whites for the analysis of racial/ethnic groups, or do we compare all of the groups to U.S.-born white men without disabilities? If the latter, does it make sense to compare all women to U.S.-born white men without disabilities or must we consider all 60 groups formed by cross-classifying the demographic variables of interest? Third, by using the same regression equation for all of the decompositions, meaningful comparisons of the salary gaps between different groups are more easily made, e.g., comparisons of the gender salary gap with the black/white salary gap.

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[43] Individuals with questions on the methodology employed are encouraged to contact Carolyn Shettle, Division of Science Resources Studies, Room 965, 4201 Wilson Boulevard, Arlington, VA 22230; (703) 306-1780; cshettle@nsf.gov. For background information on salary regression models and on variables used in this model, see Shettle (1972), Blinder (1973), Centra (1974), Kennedy (1992), Kahn (1993), and Wright (1994).

[44] When multiple dummy variables were derived from a single categorical variable, the 0.001 criterion for retention was applied to the entire categorical variable.

[45] See appendix table 5-46 for a list of the variables included in the final regression model along with estimates of the regression coefficients for the variables retained and their standard errors.

[46] This is analogous to using a pooled estimate of a proportion in calculating the standard error for the difference between two proportions, when testing the null hypothesis that the difference between two proportions is equal to 0.

To determine the sensitivity of the analysis to the choice of the regression equation used for standardization, a Oaxaca-type decomposition was made for the gender salary gap. The total percentage explained, standardizing to the equation for men rather than the total equation, was 88 percent rather than 90 percent—a fairly trivial difference. Yet another alternative is to standardize to the minority group equation.[47] Using this approach for the gender salary gap led to an estimated total percentage explained of 80 percent. Although this latter alternative provides a substantially lower estimate than that obtained for the model selected, standardization to the minority group equation is not a commonly accepted procedure.

Another approach to estimating the impact of demographic variables on salary is to do a multiple regression analysis, using dummy variables to measure the demographic groups of interest. This approach is used less frequently in the literature than is the Oaxaca approach. This approach does permit examination of the effects of each of the demographic variables of interest, however, while controlling for the other demographic variables of interest. It also has the advantage of permitting tests of significance for the effects of the demographic variables on salary and permits examination of specific interactions of interest. This approach was, therefore, used to supplement the basic decomposition approach used in the report. The parameter estimates and standard errors for this equation are included in appendix table 5-46.[48]

Variable Selection

As noted in the text, the adequacy of the analysis is contingent, in large part, on the independent variables used in the analysis. If major variables are omitted, the estimate of how much of the salary gap is “explained” will be inaccurate. Similarly, if variables that are not truly explanatory factors are included, the model will be inadequate.

As discussed in the text, some variables that could have influenced salaries (such as measures of productivity and direct measures of the relative importance of salary to other job rewards) were not collected in the SDR. Other variables were excluded for theoretical reasons or because the empirical evidence indicated that they were not, in fact, determinants of salary.

Among the available variables that were omitted for theoretical reasons, the most controversial decision was the decision to exclude academic rank and tenure. A number of analyses of the academic labor market include these variables; however, they are not always included.[49] We believe that academic rank and tenure are themselves best viewed as rewards for work performed rather than as “control” variables that help explain the salary gap.[50] To obtain an understanding of how sensitive the findings are to this particular decision, the doctoral gender salary gap was decomposed with the inclusion of academic rank and tenure in the model. The inclusion of these two variables resulted in an estimate of the explained gender gap of 91 percent rather than the 90 percent observed in the model used in chapter 5. It is thus unlikely that their inclusion would have substantially altered the findings in the chapter.[51]

We also excluded from consideration for theoretical reasons whether pay, job unavailability, or layoffs were factors in taking a job outside of the field of degree or in changing jobs. We believe that such responses may be more indicative of events that directly affect salary than they are of life choices. For example, if women and men were equally interested in being promoted, but men were promoted more often than women, men would more frequently report job changes for pay and promotion.

Note that one could argue that some of the variables included also should have been excluded. For example, one can argue that differences between groups with respect to management activities may be reflective of “discrimination” in the labor market. To the extent that this is true, one can argue that the inclusion of these variables has artificially increased the amount explained by the model.

The variables excluded for lack of statistical significance at the 0.001 level were

- *Background variables:* mother’s education, father’s education, and whether the individual lived in a rural area during the time he or she was growing up;
- *Other work-related employee characteristics:* type of work-related training (none, management or supervisor training, technical training, general training, or other training) received during the last year, the number of years of part-time work experience, whether the person has ever had foreign research experience, and whether the person changed employers between 1988 and 1993;

[47] Barbezat (1991) used this approach in addition to using the Oaxaca approach.

[48] Demographic variables presented in this appendix table were included for those demographic variables that had a statistically significant impact on salary at the 0.05 level. Excluded for lack of statistical significance were type of disability (seeing, hearing, walking, and/or lifting) and interaction terms between race and gender and between race, gender, and whether born in the United States.

[49] See Barbezat (1991) for a discussion of this issue.

[50] See Weiler (1990) for a discussion of this issue.

[51] The coefficients for this model are included in appendix table 5-46. Analysts interested in performing a more detailed analysis of the salary gap based on this model can download the relevant appendix tables in spreadsheet format through the Science Resources Studies’ Web site (http://www.nsf.gov/sbe/srs/stats.htm) or can obtain copies of the spreadsheets by contacting Carolyn Shettle (703-306-1780, cshettle@nsf.gov).

- *Employer characteristics:* whether the academic institution was a public or a private institution;[52]
- *Type of work:* whether the person worked in a field in which licensing was required, whether the position was a supervisory position, and for management positions, whether the position requires technical expertise in the natural sciences, mathematics or computer science, or engineering and whether it requires expertise in the social sciences;
- *Life choices:* number of children in the home by age category of the children (under age 6, 6–11, 12–17, and age 18 and older), whether spouse had a position that required expertise in the social sciences equivalent to that obtained with a bachelor's degree in the social sciences, and whether spouse had a position that required bachelor-level expertise in a non–science-and-engineering field. A number of the variables related to reasons for job and educational actions were also eliminated for lack of statistical significance.

Finally, some variables that would have required extensive recoding were not included because of time constraints. In making these decisions, the amount of time needed to recode the variable was weighed against the likelihood of the recoding making a significant difference in the analysis. For example, with a modest amount of effort, it would have been possible to categorize field of degree for those who obtained a degree subsequent to the doctorate. The most important fields for such a break-out, however, are indicated by the type of degree, because over half of individuals with additional degrees had degrees that indicate the field of study (MBA, M.D., and the law degrees). On the other hand, productivity measures that would have been very interesting to include would require an extensive amount of matching of data files with citation indices.

Variable Measurement

The measurement of most of the variables in this analysis was quite straightforward, given the basic coding structure of the SDR.[53] In a few cases noted below, however, some modifications to the coding need to be explained.

Salary: In the 1993 SDR, individuals were asked to report their salary or earned income for their primary job, using whatever unit (e.g., hour, week) preferred. These have been annualized on the SDR database using appropriate inflators (e.g., 2,080 times hourly wage, 52 times weekly wage). It is difficult, however, to know what the correct inflator is for academic year. The 1993 database did not inflate academic year salaries, whereas previous SDR surveys used an inflator of 11/9. The first option is tantamount to assuming that the individual does not work in the summer, and the second assumes that the individual has a typical research grant that pays 2/9 of his/her academic year salary. Although both approaches are somewhat arbitrary, using the 11/9 estimator is the more reasonable approach and is roughly comparable to multiplying a weekly wage by 52 under the assumption that the worker is employed all year.

The dependent variable in the regression analysis is the logarithm of salary, which is often used in analyzing salary, because it is consistent with the concept that salary increases are typically expressed as percentage increases rather than in absolute dollars.[54] Because the log of salary was used as the dependent variable in the regression equations, the average salaries presented in the chapter are geometric means.[55] Like the median, the geometric mean places less emphasis on extremely high values in the calculation of the average, so that the geometric means for salary will normally be lower than the mean.

Years since receipt of doctorate, age at PhD, years of full-time experience, and years of part-time experience: The model fitted included squared terms for age when the doctoral degree was received, years since receiving the doctorate, years of full-time experience, and years of part-time experience in addition to the linear terms for these variables. Incorporation of such squared terms is common in the literature (cf. Weiler 1990). Its use was also verified through visual inspection of the graphed relationships between salary and these variables and by verifying that the squared terms were statistically significant at the .001 level when incorporated into the model after inclusion of the linear terms. It should be noted that a quadratic formulation is consistent with the idea that salary may decline toward the end of one's career.

In addition to these variables, it would have been interesting to include a measure of time not in the labor force in the model, but the 1993 SDR does not include a direct measure of this.

Occupation: Occupation was measured, using NSF's standard detailed coding of occupations except for a split of non–science-and-engineering occupations

[52] This variable was close to being statistically significant. Note also that Formby et al. (1993) found this variable to be important among highly ranked economics departments.

[53] Individuals wishing a copy of the SDR code book or more information on variable coding should contact Carolyn Shettle (703-306-1780, cshettle@nsf.gov).

[54] See, for example, Barbezat (1991), Broder (1993), and Formby et. al. (1993).

[55] A geometric mean for a variable is the antilogarithm of the mean of the logarithms of the individual observations on that variable.

into "low" and "high" status occupations[56] on the basis of information from the 1993 National Survey of College Graduates (NSCG). Non–science-and-engineering occupations were classified in the "low status" category if fewer than 10 percent of the NSCG respondents in the occupation had doctorate degrees and if the average salary of NSCG respondents in the occupation in 1993 was under $45,000.

Type of employer: The SDR contains two highly related variables that describe the type of employer—sector of employment and, for those in academia, Carnegie classification of employer. Sector of employment in the SDR is based on individuals' self-report of the sector to which they belong, using the following categories: 2-year college; 4-year college; medical school; health-related school other than medical school; university-affiliated research institute; other educational institution; elementary, middle, or secondary school; private for-profit company; private not-for-profit organization; local government; State government; U.S. military service; U.S. Government (civilian employee); and other employer type.[57] The Carnegie classification of academic institutions is a commonly used classification of postsecondary institutions, based on level of degree awarded, fields in which degrees are conferred and, in some cases, enrollment, Federal research support, and selectivity of admissions criteria. It was not possible to include dummy variables for all categories of both of these variables in the regression analysis, because the high correlations between some of the sector variables and some of the Carnegie classification variables led to severe multicollinearity problems. After deletion of redundant measures, a set of dummy variables remained that are not strictly mutually exclusive but collectively describe the type of employer.

[56] The occupations included in the "low status" group included science-related fields such as technologists and technicians and computer programmers as well as occupations such as clerical/administrative support and precollegiate teachers/professors, and mechanics and repairers.

[57] Although the question permits individuals to classify themselves as self-employed, self-employed individuals were excluded from the current analysis.